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# TSR Comparison of Four-Inch Marshall-Compacted and Six-Inch Gyratory-Compacted Specimens

## FINAL REPORT

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**16. Abstract**

The test method used by many state agencies to determine the tendency of an asphalt mixture to be susceptible to moisture damage is AASHTO T-283, *Resistance of Compacted Bituminous Mixture to Moisture Induced Damage*. This method has typically utilized 4-inch diameter specimens compacted in the Marshall hammer. The objective of this research project was to develop a TSR criteria for 6-inch gyratory specimens that corresponds to the TSR criteria currently used for 4-inch Marshall compacted specimens in Illinois, which would allow Marshall compaction to be phased out. In this study, representative asphalt mixtures were tested that contained the general aggregate types used in Illinois. Plant-produced mixes and lab-produced mixes were sampled and tested.

The results of this study indicated that: (1) The strength of specimens from plant-produced mixtures was greater than the strength of lab-produced mixes. (2) The strength of unconditioned specimens was greater than conditioned specimens. (3) The strength of 4-inch diameter specimens was greater than the strength of 6-inch specimens. (4) The strength of 4-inch unconditioned specimens and 6-inch unconditioned and conditioned specimens resulted in a more consistent pattern than did the conditioned strength from 4-inch conditioned specimens. (5) The TSR from 6-inch diameter specimens was larger than the TSR of 4-inch diameter specimens.

A TSR criteria of 0.85 for 6-inch diameter gyratory-compacted specimens was recommended.
Also, considering a minimum tensile strength of 60 psi, in addition to the TSR criteria, was recommended.

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# EXECUTIVE SUMMARY

Stripping, or moisture damage, occurs in an asphalt mixture when the adhesive bond between the asphalt and the aggregates is weakened or broken due to the action of moisture. Stripping contributes to pavement distresses including rutting, raveling, and cracking, all of which can significantly reduce the service life and performance of hot mix asphalt pavements.

The test method used by many state agencies to determine the tendency of an asphalt mixture to be susceptible to moisture damage is AASHTO T-283, *Resistance of Compacted Bituminous Mixture to Moisture Induced Damage*. This method has typically utilized 4-inch diameter specimens compacted in the Marshall hammer.

In the 1990's, AASHTO T-283 was incorporated into the Superpave mix design method. This method used the Superpave gyratory compactor which produces 150-mm (6-inch) diameter specimens. As a result, questions have been raised of whether the results of testing the 150-mm diameter gyratory specimens would compare with those of the smaller, Marshall specimens.

Since a correlation had not been established in Illinois between the AASHTO T-283 results of 4-inch Marshall compacted specimens and 6-inch gyratory compacted specimens, this study was necessary to completely implement Superpave methods in Illinois.

The objective of this research project, begun in the fall of 2000, was to develop a TSR criteria for 6-inch gyratory specimens that corresponds to the TSR criteria currently used for 4-inch Marshall compacted specimens in Illinois, which would allow Marshall compaction to be phased out.

In this study, representative asphalt mixtures were tested that contained the general aggregate types used in Illinois. The coarse aggregate types included limestone, dolomite, crushed gravel, steel slag, air-cooled blast furnace slag, sandstone, and chert. The fine aggregates included natural sand, crushed gravel sand, crushed limestone, crushed dolomite, and crushed steel slag.

Plant-produced mix was sampled and collected for twelve different designs. The component materials for ten of the plant-produced mixes plus an additional mix were also sampled and tested.

Illinois-modified AASHTO T-283 was followed for all testing. In this study, two sets of 4-inch diameter specimens and two sets of 6-inch diameter specimens were tested for each mixture, for both the plant-produced and lab-produced mixtures.

After all preparation and conditioning, each specimen was broken in the indirect tensile tester using the correct loading head for the 4-inch and 6-inch diameter specimens. The indirect tensile strength, in psi, was determined for each specimen.

The TSR (conditioned tensile strength / unconditioned tensile strength) was calculated for each set of 4-inch Marshall compacted specimens and each set of 6-inch gyratory compacted specimens.

The results of this study indicated that:

- The strength of specimens from plant-produced mixtures was greater than the strength of lab-produced mix.
- The strength of unconditioned specimens was greater than conditioned specimens.
- The strength of 4-inch diameter specimens was greater than the strength of 6-inch specimens.
- The strength of 4-inch unconditioned specimens and 6-inch unconditioned and conditioned specimens resulted in a more consistent pattern than did the conditioned strength from 4-inch conditioned specimens.
- The TSR from 6-inch diameter specimens was larger than the TSR of 4-inch diameter specimens.

A TSR criteria of 0.85 for 6-inch diameter gyratory-compacted specimens was recommended. This corresponds with the current TSR criteria of 0.75 for Marshall-compacted specimens.

Also, considering a minimum tensile strength of 60 psi, in addition to the TSR criteria, was recommended.

# DISCLAIMER

The contents of this paper reflect the views of the author who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official views, or policies of the Illinois Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

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# INTRODUCTION

## *BACKGROUND*

Stripping occurs in an asphalt mixture when the adhesive bond between the asphalt and the aggregates is weakened or broken due to the action of moisture. Stripping, or moisture damage, contributes to pavement distresses including rutting, raveling, and cracking, all of which can significantly reduce the service life and performance of hot mix asphalt pavements.

The test method used by many state agencies to determine the tendency of an asphalt mixture to be susceptible to moisture damage is AASHTO T-283, *Resistance of Compacted Bituminous Mixture to Moisture Induced Damage* [1]. This method has typically utilized 4-inch diameter specimens compacted in the Marshall hammer. Although 6-inch diameter specimens have been allowed in AASHTO T-283, their use has been uncommon.

In the 1990's, AASHTO T-283 was incorporated into the Superpave mix design method. This method used the Superpave gyratory compactor which produces 150-mm (6-inch) diameter specimens. As a result, questions have been raised of whether the results of testing the 150-mm diameter gyratory specimens would compare with those of the smaller, Marshall specimens.

NCHRP Project 9-13 [2] was developed "to evaluate AASHTO T-283 and to recommend changes to make it compatible with the Superpave system." This NCHRP project was completed in August 1999. One of the findings of that study was that the tensile strengths and the tensile strength ratios (TSRs) from 6-inch diameter gyratory compacted specimens was similar to those from 4-inch diameter Marshall compacted specimens. This study encouraged public agencies, which use the 4-inch Marshall compactor for determining the water sensitivity of hot mix asphalt (HMA) by AASHTO T-283, to perform a structured laboratory testing program to compare the behavior of their locally available aggregates and asphalt binders before switching to the 6-inch gyratory compactor.

Since a correlation had not been established in Illinois between the AASHTO T-283 results of 4-inch Marshall compacted specimens and 6-inch gyratory compacted specimens, this study was necessary to completely implement Superpave methods in Illinois.

## *PROJECT OBJECTIVE*

The objective of this research project, begun in the fall of 2000, was to develop a TSR criteria for 6-inch gyratory specimens that corresponds to the TSR criteria currently used for 4-inch Marshall compacted specimens in Illinois, which would allow Marshall compaction to be phased out.

# PLAN OF STUDY

## *MATERIALS*

In this study, representative asphalt mixtures were tested that contained the general aggregate types used in Illinois. The coarse aggregate types included limestone, dolomite, crushed gravel, steel slag, air-cooled blast furnace slag, sandstone, and chert. The fine aggregates included natural sand, crushed gravel sand, crushed limestone, crushed dolomite, and crushed steel slag.

Each of the nine districts in Illinois was asked to provide one or two representative, but different, mix designs with low or borderline design TSR values from 4-inch Marshall specimens. All but one of the mix designs provided was for surface mix. Surface mixtures were selected to reduce the variability due to differences in particle size.

Three of the mixtures included for testing contained polymer-modified asphalt binder. These designs were from lab #023, #033A, and #033B. The polymer-modified asphalt was used in these mixtures both in the plant-produced and the lab-produced mixtures. One of these plant-produced mixtures with polymer-modified asphalt (#033B) also contained 0.5% liquid anti-strip. The liquid anti-strip was not added to this same mixture produced in the lab.

### Plant-Produced, Lab-Compacted Mix

Plant-produced mix was sampled and collected for twelve different designs. The materials contained in each of those twelve designs and some background information is given in **Table 1**. AASHTO T-283 is generally not performed in Illinois on plant-produced mixtures. However, since blending and mixing was already complete when the samples were collected, the subsequent testing time was considerably less, giving initial results to compare 4-inch and 6-inch diameter specimens more quickly. Also, the range of results between plant-produced and lab-produced mixtures was compared for the two specimen sizes.

**Table 1**

**Materials Used in 4-inch -vs- 6-inch TSR Study (Plant Mix)**

| | | Coarse Aggregates | | Fine Aggregates | | Binder | | Design TSR (4") |
|---|---|---|---|---|---|---|---|---|
| District | Lab # | % Used | Description | % Used | Description | % Used | PG Grade | |
| 4 | 021 | 36.0 | Steel Slag CMM13 | 10.0 | Steel Slag Sand FAM20 | 5.6 | PG 64-22 | 0.86 |
| | | 32.5 | Crushed Gravel CMM13 | 18.0 | Natural Sand FAM01 | | | |
| | | | | 3.5 | Mineral Filler MFM01 | | | |
| 4 | 022 | 41.1 | Crushed Dolomite CMM11 | 15.0 | Natural Sand FAM01 | 4.6 | PG 64-22 | NA |
| | | 32.0 | Crushed Dolomite CMM16 | 10.0 | Steel Slag FAM20 | | | |
| | | | | 1.9 | Mineral Filler MFM01 | | | |
| 8 | 023 | 30.0 | ACBF Slag CMM13 | 23.2 | Crushed Limestone Sand FAM20 | 6.1 | SBS PG 64-22 | 0.88 |
| | | 33.0 | Crushed Limestone CMM13 | 9.3 | Natural Sand FAM01 | | | |
| | | | | 4.5 | Mineral Filler MFM01 | | | |
| 2 | 025 | 69.0 | Crushed Dolomite CMM13 | 7.0 | Crushed Dolomite Sand FAM21 | 5.3 | PG 64-22 | 0.77 |
| | | | | 10.0 | Steel Slag Sand FAM20 | | | |
| | | | | 14.0 | Natural Sand FAM01 | | | |
| 5 | 027 | 56.0 | Crushed Gravel CMM16 | 20.5 | Crushed Gravel Sand FAM20 | 5.5 | PG 64-22 | 0.78 |
| | | | | 19.4 | Natural Sand FAM01 | | | |
| | | | | 4.1 | Mineral Filler MFM01 | | | |
| 9 | 033A | 16.0 | Crushed Sandstone CM13 | 29.7 | Crushed Limestone Sand FAM20 | 5.2 | SBS PG 64-22 | 0.81 |
| | | 43.1 | Crushed Limestone CMM16 | 11.2 | Natural Sand FAM01 | | | |
| 9 | 033B | 65.8 | Crushed Sandstone CM13 | 26.2 | Crushed Limestone Sand FA20 | 5.2 | SBS PG 64-22 | 0.77 |
| | | | | 8.0 | Natural Sand FAM01 | | | |
| 6 | 038 | 71.0 | Crushed Limestone CMM16 | 15.0 | Crushed Limestone Sand FMM21 | 5.0 | PG 64-22 | 0.81 |
| | | | | 14.0 | Natural Sand FAM01 | | | |
| 7 | 229 | 65.0 | Crushed Limestone CMM16 | 31.5 | Natural Sand FAM01 | 5.0 | PG 64-22 | 0.76 |
| | | | | 3.5 | Mineral Filler MFM01 | | | |
| 3 | 230 | 65.0 | Crushed Dolomite CMM16 | 17.5 | Crushed Dolomite Sand FAM20 | 5.7 | PG 64-22 | 0.65 (IDOT) |
| | | | | 17.5 | Natural Sand FAM01 | | | |
| 5 | 231 | 32.4 | Crushed Limestone CMM16 | 32.0 | Natural Sand FAM01 | 5.4 | PG 64-22 | 0.87 |
| | | 31.9 | Crushed Gravel CMM16 | 3.7 | Mineral Filler MFM01 | | | |
| 7 | 232 | 62.0 | Crushed Limestone CMM16 | 12.0 | Crushed Limestone Sand FAM20 | 5.2 | PG 64-22 | 0.81 |
| | | | | 24.0 | Natural Sand FAM01 | | | |
| | | | | 2.0 | Mineral Filler MFM01 | | | |

## Lab-Produced, Lab-Compacted Mix

The component materials for the first ten of the plant-produced mixes were also sampled and collected. In addition to the plant-produced mixes, the component materials for an additional design was collected and processed in the lab. The materials contained in each of those eleven designs and some background information is given in **Table 2**.

**Table 2**

**Materials Used in 4-inch -vs- 6-inch TSR Study (Lab Mix)**

| | | Coarse Aggregates | | Fine Aggregates | | Binder | | Design TSR (4") |
|---|---|---|---|---|---|---|---|---|
| District | Lab # | % Used | Description | % Used | Description | % Used | PG Grade | |
| 4 | 021 | 36.0 | Steel Slag CMM13 | 10.0 | Steel Slag Sand FAM20 | 5.6 | PG 64-22 | 0.86 |
| | | 32.5 | Crushed Gravel CMM13 | 18.0 | Natural Sand FAM01 | | | |
| | | | | 3.5 | Mineral Filler MFM01 | | | |
| 4 | 022 | 41.1 | Crushed Dolomite CMM11 | 15.0 | Natural Sand FAM01 | 4.6 | PG 64-22 | NA |
| | | 32.0 | Crushed Dolomite CMM16 | 10.0 | Steel Slag FAM20 | | | |
| | | | | 1.9 | Mineral Filler MFM01 | | | |
| 8 | 023 | 30.0 | ACBF Slag CMM13 | 23.2 | Crushed Limestone Sand FAM20 | 6.1 | SBS PG 64-22 | 0.88 |
| | | 33.0 | Crushed Limestone CMM13 | 9.3 | Natural Sand FAM01 | | | |
| | | | | 4.5 | Mineral Filler MFM01 | | | |
| 2 | 025 | 69.0 | Crushed Dolomite CMM13 | 7.0 | Crushed Dolomite Sand FAM21 | 5.3 | PG 64-22 | 0.77 |
| | | | | 10.0 | Steel Slag Sand FAM20 | | | |
| | | | | 14.0 | Natural Sand FAM01 | | | |
| 5 | 027 | 56.0 | Crushed Gravel CMM16 | 20.5 | Crushed Gravel Sand FAM20 | 5.5 | PG 64-22 | 0.78 |
| | | | | 19.4 | Natural Sand FAM01 | | | |
| | | | | 4.1 | Mineral Filler MFM01 | | | |
| 9 | 033A | 16.0 | Crushed Sandstone CM13 | 29.7 | Crushed Limestone Sand FAM20 | 5.2 | SBS PG 64-22 | 0.81 |
| | | 43.1 | Crushed Limestone CMM16 | 11.2 | Natural Sand FAM01 | | | |
| 9 | 033B | 65.8 | Crushed Sandstone CM13 | 26.2 | Crushed Limestone Sand FA20 | 5.2 | SBS PG 64-22 | 0.77 |
| | | | | 8.0 | Natural Sand FAM01 | | | |
| 6 | 038 | 71.0 | Crushed Limestone CMM16 | 15.0 | Crushed Limestone Sand FMM21 | 5.0 | PG 64-22 | 0.81 |
| | | | | 14.0 | Natural Sand FAM01 | | | |
| 7 | 229 | 65.0 | Crushed Limestone CMM16 | 31.5 | Natural Sand FAM01 | 5.0 | PG 64-22 | 0.76 |
| | | | | 3.5 | Mineral Filler MFM01 | | | |
| 3 | 230 | 65.0 | Crushed Dolomite CMM16 | 17.5 | Crushed Dolomite Sand FAM20 | 5.7 | PG 64-22 | 0.65 (IDOT) |
| | | | | 17.5 | Natural Sand FAM01 | | | |
| 8 | Chert | 30.1 | Crushed Chert Gravel CMM13 | 19.1 | Cruched Sand FAM20 | 5.5 | PG 64-22 | 0.75 |
| | | 30.1 | Crushed Stone CMM13 | 19.0 | Crushed Sand FAM20 | | | |
| | | | | 1.7 | Mineral Filler MF01 | | | |

## *TESTING WORKPLAN*

Illinois-modified AASHTO T-283 was followed for all testing. The primary differences contained in the Illinois-modified version are (1) the specimens are not subjected to a freeze cycle, (2) the specimens are not cured for 16 hours in a 140°F oven, and (3) the specimens are not required to be stored at room temperature for 72 to 96 hours after being extracted from the molds.

T-283 specifies that for each testing set, three specimens are tested with no conditioning and that three specimens are tested after being conditioned. Two additional specimens are prepared to determine the correct level of compaction. Therefore, each complete testing set contains eight individual specimens. In this study, two sets of 4-inch diameter specimens and two sets of 6-inch diameter specimens were tested for each mixture, for both the plant-produced and lab-produced mixtures. The only exception to this was on the mixture from lab #027. Only one set of 6-inch diameter specimens was prepared and tested because of a shortage of component materials.

The samples for both the plant-produced mixtures and the component materials for the lab-produced mixtures were reduced to the proper specimen size by using a mechanical splitter. Although fractionalizing all the aggregates for the lab-produced mixtures was considered, it was decided that the potential benefit did not justify the additional time required. This was especially true when considering the inherent variability in the testing results produced by T-283.

The testing times, temperatures, and procedures were kept the same for both the 4-inch specimens and the 6-inch specimens. As a result, the only intended variable was the specimen size. The height to diameter ratio was kept the same for both sizes of specimens. The height of the 4-inch specimens was 2.5 inches. The corresponding height of the 6-inch specimens was 95 mm (3.75 inches).

The maximum specific gravity ($G_{mm}$) was run at least once for each mixture, according to Illinois-modified AASHTO T-209 *Maximum Specific Gravity of Bituminous Paving Mixtures*.

The bulk specific gravity ($G_{mb}$) was run on each specimen, according to Illinois-modified T-166 *Bulk Specific Gravity of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens*.

The specimens were all compacted to 7±1 % air voids.

All the conditioned specimens were saturated to 70±2 %. The values for 68% and 72% saturation were calculated. The vacuum level was initially started low and increased by appropriate small increments until the saturation was between the values for 68% and 72%.

After all preparation and conditioning in the 140°F water bath, each specimen was broken in the indirect tensile tester using the correct loading head for the 4-inch and 6-inch diameter specimens. The indirect tensile strength, in psi, was determined for each specimen.

The TSR (conditioned tensile strength / unconditioned tensile strength) was calculated for each set of 4-inch Marshall compacted specimens and each set of 6-inch gyratory compacted specimens.

The 6-inch specimens for mixture #038 were inadvertently blended and compacted to 105 mm (4.1 inch) height instead of the correct height of 95 mm. Two rerun sets of 6-inch specimens were compacted to a height of 95 mm and tested. The results for the 4-inch specimens from both the original (#038) and the rerun samples were averaged and reported. For the 6-inch specimens, only the results from the rerun specimens were used and reported.

Visual strip ratings were assigned to the split 6-inch specimens for mixture #038ReRun, and all the specimens for mixtures #229, #033A, #033B and the Chert mixture. The coarse and fine aggregates were rated separately and given a numerical rating of “1”, “2”, or “3” representing little or no stripping, moderate stripping, or serious stripping, respectively.

# DATA, RESULTS, AND OBSERVATIONS

## *RESULTS*

A summary of the average unconditioned and conditioned tensile strengths and the TSRs for both the plant-produced mixes and the lab-produced mixes is shown in **Table 3**. Copies of all the tensile strength and TSR worksheets used for this study are included in **Appendix A**.

**Table 3**

## 4-inch -vs- 6-inch TSR Study Summary

| | COMBINED: PLANT MIX and LAB MIX | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | AVERAGE STRENGTH (psi) | | | | | | | | TSR | | | TSR | | |
| | 4-inch Plant | | 4-inch Lab | | 6-inch Plant | | 6-inch Lab | | Plant Mix | | | Lab Mix | | |
| Mix ID & District | Uncond | Cond | Uncond | Cond | Uncond | Cond | Uncond | Cond | 4-inch | 6-inch | Difference 6"- 4" | 4-inch | 6-inch | Difference 6"- 4" |
| 021 District 4 | 110.2 | 101.0 | 99.2 | 93.4 | 80.5 | 77.0 | 70.4 | 65.8 | 0.916 | 0.956 | 0.040 | 0.941 | 0.935 | -0.007 |
| 022 District 4 | 146.2 | 134.8 | 136.6 | 86.5 | 108.7 | 106.7 | 105.4 | 90.7 | 0.922 | 0.981 | 0.059 | 0.633 | 0.860 | 0.227 |
| 023 District 8 | 151.6 | 126.7 | 130.4 | 96.9 | 128.5 | 116.7 | 110.0 | 95.2 | 0.836 | 0.908 | 0.073 | 0.743 | 0.866 | 0.123 |
| 025 District 2 | 169.1 | 136.7 | 117.3 | 89.7 | 130.4 | 114.3 | 84.8 | 73.2 | 0.808 | 0.876 | 0.068 | 0.765 | 0.862 | 0.098 |
| 027 District 5 | 173.5 | 151.2 | 135.6 | 92.0 | 128.5 | 117.4 | 88.8 | 79.6 | 0.872 | 0.914 | 0.042 | 0.679 | 0.896 | 0.218 |
| 033A District 9 | 191.0 | 141.1 | 53.0 | 42.5 | 155.1 | 133.9 | 51.6 | 43.2 | 0.739 | 0.863 | 0.124 | 0.801 | 0.838 | 0.037 |
| 033B District 9 | 197.1 | 120.7 | 54.5 | 38.1 | 165.5 | 125.7 | 50.1 | 41.2 | 0.612 | 0.759 | 0.147 | 0.698 | 0.823 | 0.125 |
| 038 Avg District 6 | 167.4 | 97.2 | 101.9 | 79.2 | 123.3 | 87.5 | 64.8 | 61.4 | 0.581 | 0.709 | 0.129 | 0.777 | 0.948 | 0.171 |
| 229 District 7 | 153.3 | 122.2 | 101.1 | 80.9 | 125.7 | 107.5 | 81.6 | 70.1 | 0.797 | 0.855 | 0.058 | 0.801 | 0.859 | 0.058 |
| 230 District 3 | 153.6 | 132.9 | 111.0 | 74.0 | 122.6 | 111.3 | 79.3 | 69.3 | 0.865 | 0.908 | 0.042 | 0.667 | 0.874 | 0.207 |
| 231 District 5 | 131.9 | 117.8 | | | 90.5 | 84.9 | | | 0.893 | 0.938 | 0.045 | | | |
| 232 District 7 | 152.0 | 138.5 | | | 106.5 | 101.9 | | | 0.911 | 0.957 | 0.046 | | | |
| District 8 Chert | | | 81.6 | 59.4 | | | 68.8 | 51.0 | | | | 0.728 | 0.742 | 0.014 |
| **AVERAGE** | **158.1** | **126.7** | **102.0** | **75.7** | **122.2** | **107.1** | **77.8** | **67.3** | **0.813** | **0.885** | **0.073** | **0.748** | **0.864** | **0.115** |

The average tensile strength from the plant-mix specimens was larger than the average tensile strength from the lab-mix specimens for each mix, when the same size specimens with the same level of conditioning were compared. This was expected since plant-produced mixes typically age and harden more than comparable lab-produced mixes.

For every mix, both plant-produced and lab-produced, the average unconditioned tensile strength of 4-inch specimens was greater than the average unconditioned strength for 6-inch specimens by an average of almost 31 psi.

For all but one of the plant-produced mixes, the average conditioned strength of the 4-inch specimens was larger than the average conditioned strength of the 6-inch specimens by an average of about 22 psi. The one exception was from lab mix #033B where the plant-produced mix had an average 6-inch conditioned strength that was 5 psi greater than the average conditioned strength of the 4-inch specimens.

For nine of the lab-produced mixes, the average conditioned strength of the 4-inch specimens was larger than the average conditioned strength of the 6-inch specimens by an average of about 13 psi. The three exceptions were from mix ID numbers #022, #033A, and #033B where the lab-produced mix had an average 6-inch conditioned strength that was about 3 psi greater than the average conditioned strength of the 4-inch specimens.

The average TSR of the plant-produced mix was 0.813 for the 4-inch diameter specimens and 0.885 for the 6-inch diameter specimens. The TSRs for the 4-inch specimens ranged from 0.581 to 0.922. The TSRs for the 6-inch specimens ranged from 0.709 to 0.981. The average difference between the TSR values for the two sample sizes was 0.073. The maximum difference was 0.147 and the minimum difference was 0.040.

The average TSR of the lab-produced mix was 0.748 for the 4-inch diameter specimens and 0.864 for the 6-inch diameter specimens. The TSRs for the 4-inch specimens ranged from 0.633 to 0.941. The TSRs for the 6-inch specimens ranged from 0.742 to 0.948. The average difference between the TSR values for the two sample sizes was 0.115. The maximum difference was 0.227 and the minimum difference was 0.007.

## *OBSERVATIONS*

### Tensile Strength

A summary of the statistics from all the individual specimens from the different specimen size and conditioning groups is shown in **Table 4.** The lowest average tensile strength of 66.7 psi is from the lab-produced, 6-inch, conditioned specimens.

**Table 4**

**STRENGTH STATISTICS SUMMARY**

| | PLANT | | | | LAB | | | |
|---|---|---|---|---|---|---|---|---|
| | 4" Uncond Strength (psi) | 6" Uncond Strength (psi) | 4" Cond Strength (psi) | 6" Cond Strength (psi) | 4" Uncond Strength (psi) | 6" Uncond Strength (psi) | 4" Cond Strength (psi) | 6" Cond Strength (psi) |
| **Average** | 158.1 | 122.2 | 126.8 | 107.1 | 102.0 | 77.2 | 76.0 | **66.7** |
| **Std Dev** | 23.9 | 23.4 | 16.8 | 16.7 | 28.3 | 19.3 | 20.2 | 17.6 |
| **Max** | 211.7 | 172.6 | 157.6 | 138.6 | 146.4 | 115.2 | 125.7 | 99.0 |
| **Min** | 102.7 | 75.0 | 85.9 | 72.9 | 49.3 | 48.1 | 34.2 | 36.8 |
| **Range** | 109.0 | 97.6 | 71.7 | 65.7 | 97.1 | 67.1 | 91.5 | 62.2 |
| Average - 1 Standard Deviation | 134.2 | 98.8 | 110.0 | 90.4 | 73.7 | 58.0 | 55.8 | 49.1 |

| | ALL | ALL Plant | ALL Lab | 4" Plant | 6" Plant | 4" Lab | 6" Lab | Plant Uncond | Plant Cond | Lab Uncond | Lab Cond |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Average** | 105.5 | 128.5 | 81.1 | 142.5 | 114.6 | 89.0 | 72.0 | 140.1 | 116.9 | 90.5 | 71.7 |
| **Std Dev** | 35.7 | 27.6 | 25.6 | 25.9 | 21.6 | 27.8 | 19.1 | 29.6 | 19.4 | 27.4 | 19.5 |
| **Max** | 211.7 | 211.7 | 146.4 | 211.7 | 172.6 | 146.4 | 115.2 | 211.7 | 157.6 | 146.4 | 125.7 |
| **Min** | 34.2 | 72.9 | 34.2 | 85.9 | 72.9 | 34.2 | 36.8 | 75.0 | 72.9 | 48.1 | 34.2 |
| **Range** | 177.5 | 138.8 | 112.2 | 125.8 | 99.7 | 112.2 | 78.4 | 136.7 | 84.7 | 98.3 | 91.5 |
| **Average - 1 Standard Deviation** | 69.9 | 100.9 | 55.5 | 116.7 | 93.0 | 61.2 | 52.8 | 110.5 | 97.5 | 63.0 | 52.1 |

The average tensile strength for the specimens from all of the twelve plant-produced mixtures is shown in **Figure 1**. The average tensile strength for the specimens from all of the twelve lab-produced mixtures is shown in **Figure 2**. Both figures show that for each mixture, the average unconditioned strength of the 4-inch specimens produced the largest value. The average conditioned strength from the 6-inch specimens, on the other hand, consistently produced the smallest value while the average unconditioned strength from the 6-inch specimens produced a value somewhere between the other two. The average conditioned strength values for the 4-inch specimens, from both the plant-produced mixes and the lab-produced mixes, was more variable. It ranged from considerably larger than the average 6-inch unconditioned strength to smaller than the 6-inch average conditioned strength.

**Figure 3** compares the average strength of plant-produced mixes with the average strength of lab-produced mixes. This very oversimplified graph shows the average of all the plant-produced mixes (includes both the 4-inch and 6-inch specimens) with the solid line and the average of all the lab-produced mixes (includes both the 4-inch and 6-inch specimens) with the dashed line. The two mixtures with the highest average plant-produced strength (033A and 033B) also had the lowest average lab-produced strength. The original coarse aggregates for each of these two lab-produced mixes had excessive fines and did not meet gradation requirements for most of the sieve sizes. As a result, all the aggregates for these two mixes were re-sampled and the two lab-produced mixes were made from the re-sampled aggregates. This may account, at least in part, for the strength difference between the plant-produced and lab-produced specimens for these two mixtures. Also, liquid anti-strip was included in the plant-produced mix for mixture #033B during production. As a result, all twelve of the 4-inch specimens and all twelve of the 6-inch specimens from the plant-produced mix contained liquid anti strip. Liquid anti-strip was not included in any of the lab-produced specimens for mixture #033B.

**Figure 1**

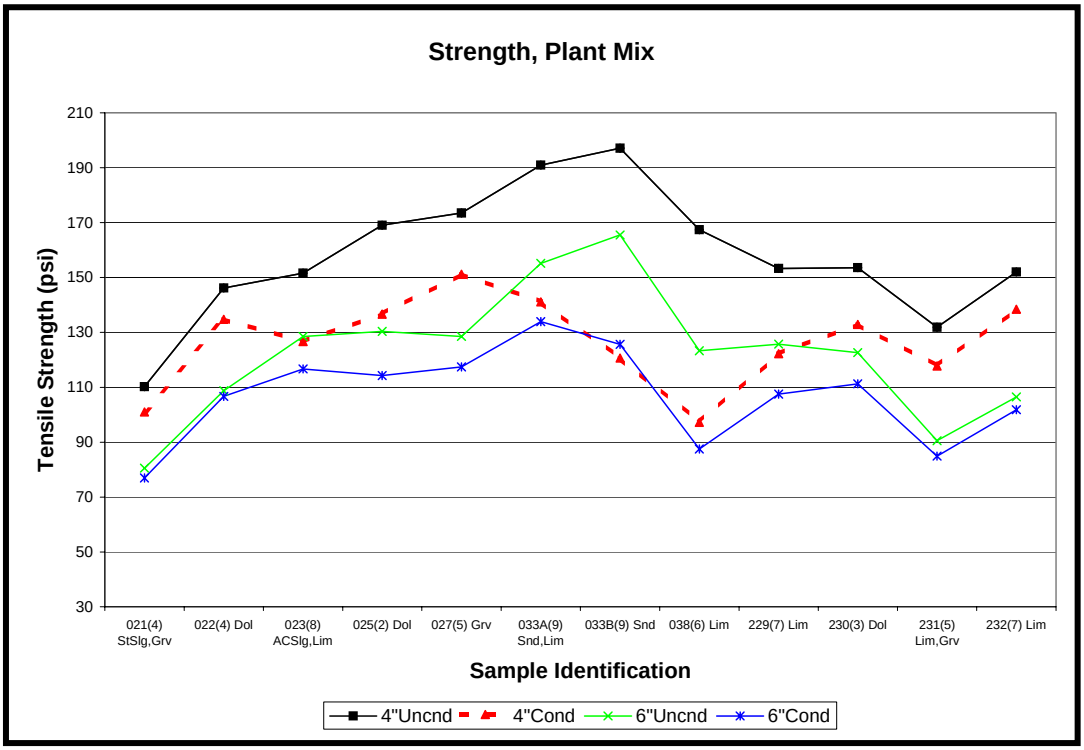


**Figure 2**

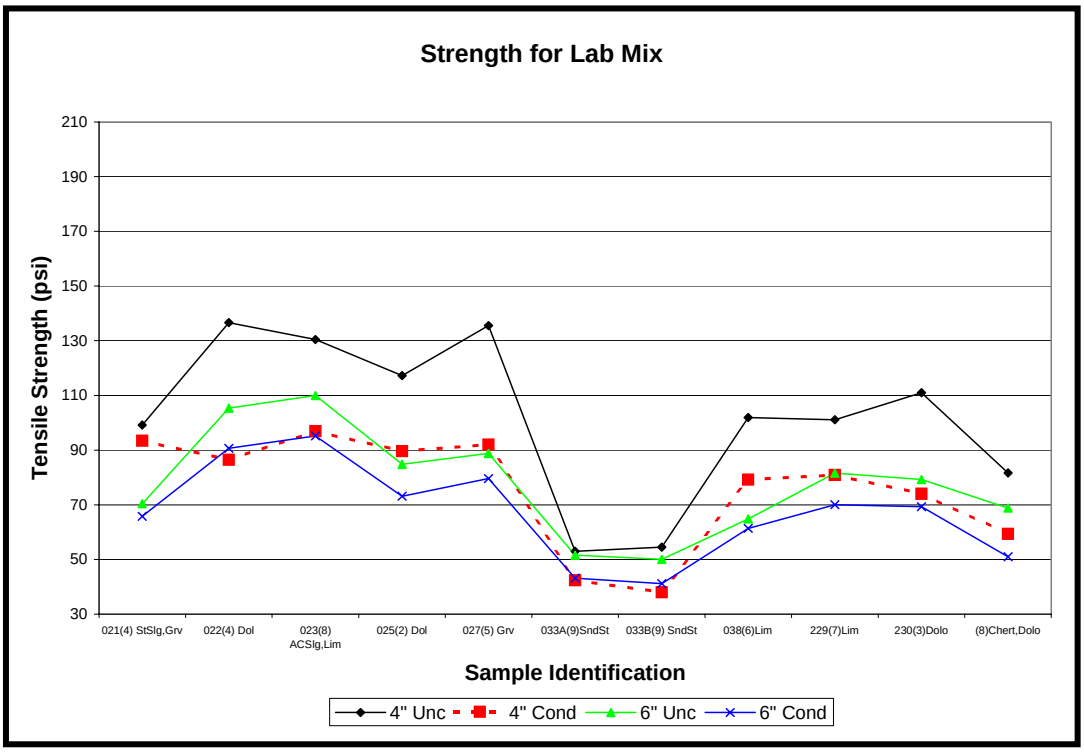
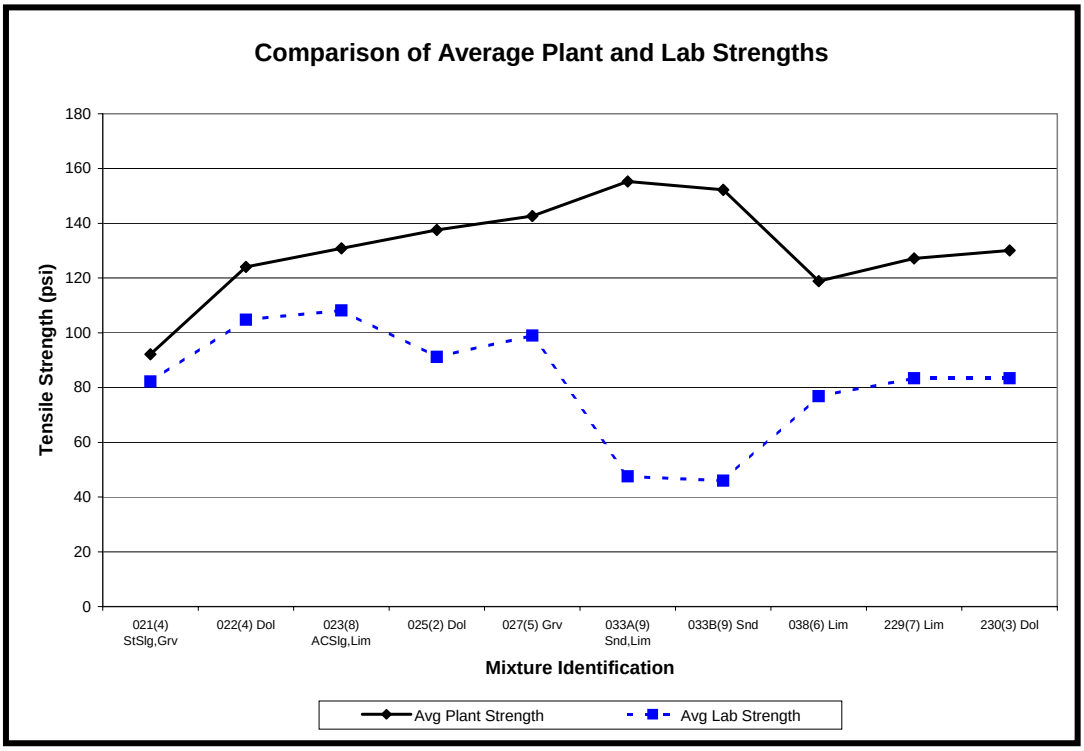



**Figure 3**



## TSR

The TSR from the 4-inch specimens from each plant-produced and lab-produced mixture is shown in **Figure 4**. The average difference between the 4-inch TSR from the plant-produced mix and the lab-produced mix was 0.119. The standard deviation of the differences was 0.094 and the range between the differences was 0.286. There is no clear pattern or trend that connects the 4-inch TSR values of each of the plant-produced and lab-produced mixes.

The TSR from the 6-inch specimens from each plant-produced and lab-produced mixture is shown in **Figure 5**. The average difference between the 6-inch TSR from the plant-produced mix and the lab-produced mix was 0.058. The standard deviation of the differences was 0.072 and the range between the differences was 0.235. The 6-inch TSR difference between plant-produced and lab-produced mixes is closer and more consistent.

**Figure 4**

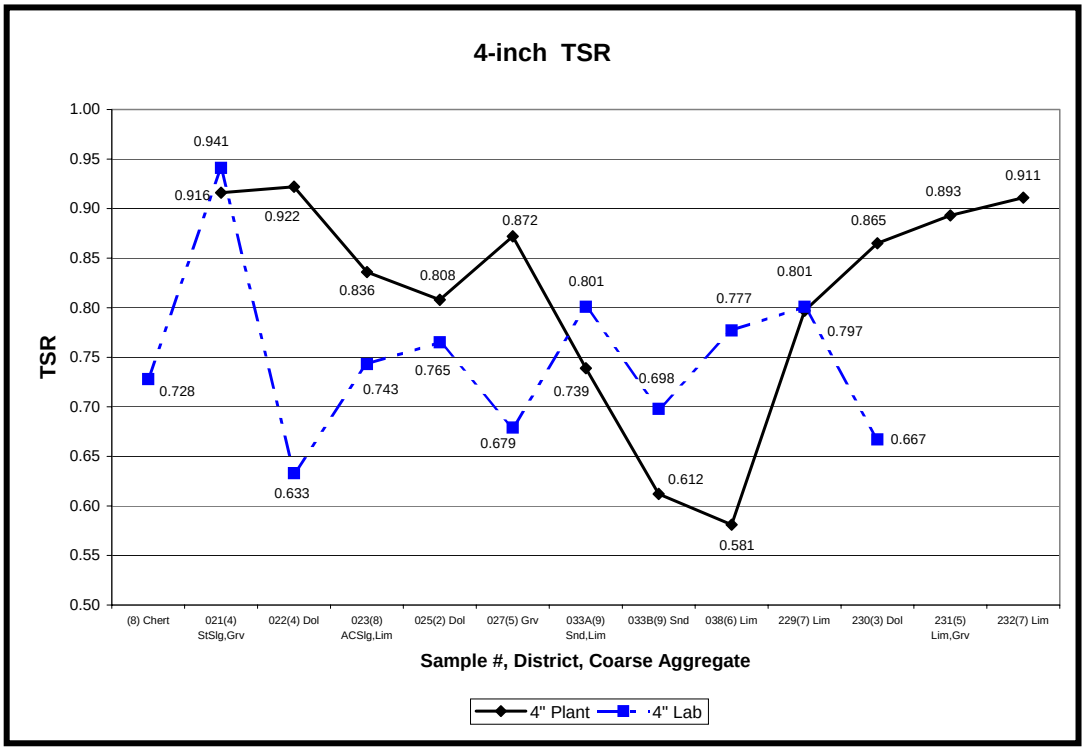


**Figure 5**

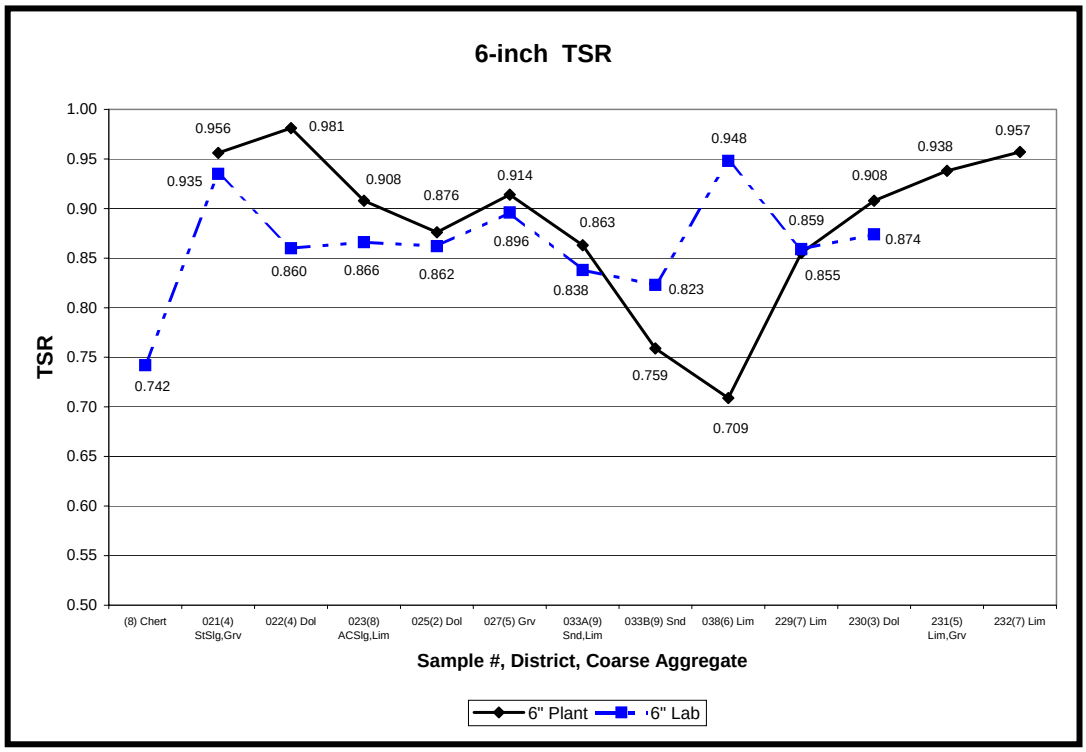



**Figure 6** shows the TSR from the plant-produced mixtures for both the 4-inch and 6-inch specimens. The TSR from the 6-inch specimens was larger than the TSR from the 4-inch specimens, for each of the twelve mixtures, by an average of 0.073. The minimum difference was 0.040 and the maximum difference was 0.147. The difference was reasonably consistent. Generally, the larger TSR values showed a smaller difference between the two specimen sizes and the specimens with the smaller TSR values showed a larger difference between the two sizes.

**Figure 6**

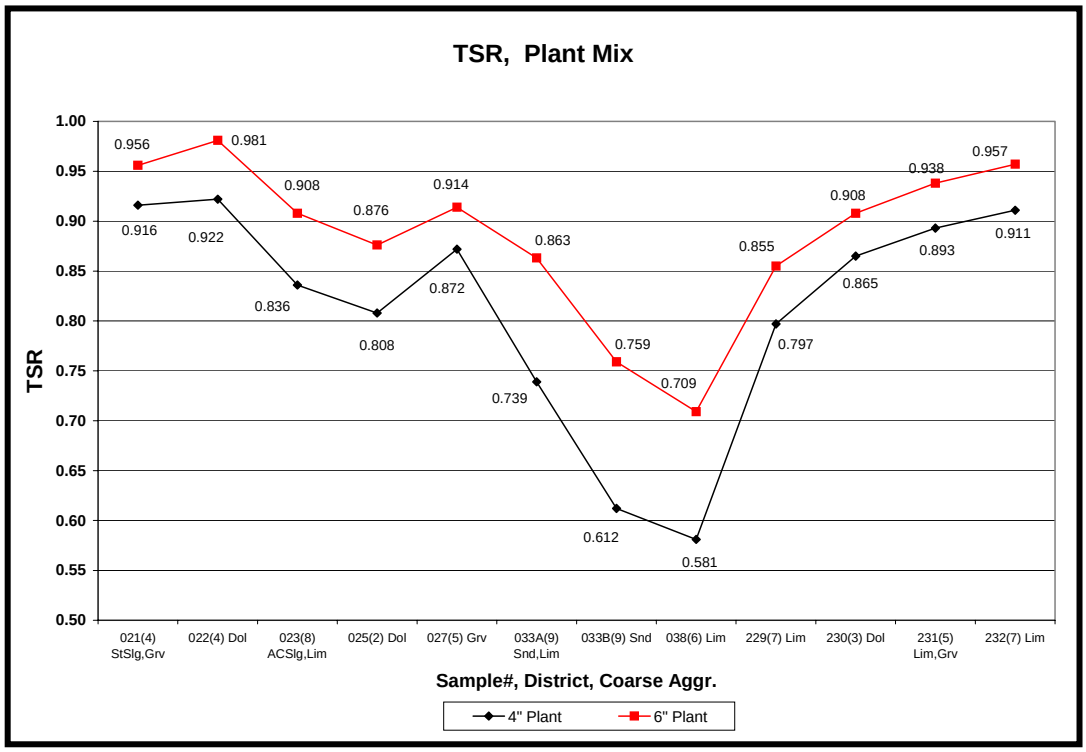



**Figure 7** shows the TSR of the lab-produced mixtures for both the 4-inch and the 6-inch specimens. The TSR from the 6-inch specimens was larger than the TSR from the 4-inch specimens, for all but one of the twelve mixtures (#021). The average difference between the TSR values from the two sample sizes was 0.115. The minimum difference was 0.007 on mixture #021, where the TSR from the 4-inch specimens was slightly larger than the TSR from the 6-inch specimens. The maximum difference between the TSR values from the two specimen sizes was 0.227. There was no clear trend between the differences from the two specimen sizes. The magnitude of the TSR did not indicate the magnitude of the difference between the two specimen sizes.

**Figure 7**

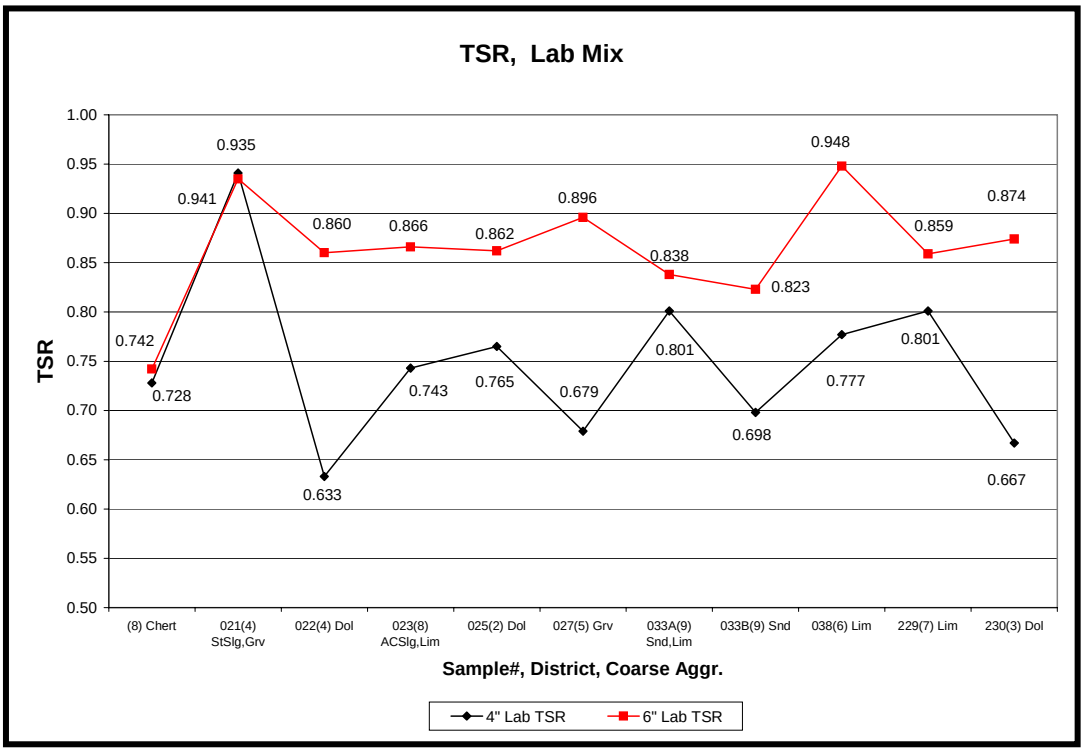



**Figure 8** and Figure **9** show the relationship between the TSR values of the 4-inch specimens and 6-inch specimens for the plant-produced mixes and for the lab-produced mixes. The $R^2$ value is given on each graph. The $R^2$ value of 0.965 (**Figure 8**) indicates a strong correlation between the TSR values from the two specimen sizes for the plant-produced mixtures. On the other hand, the $R^2$ value of 0.121 (**Figure 9**) indicates a very weak correlation between the TSR values for the two specimen sizes from the lab-produced mixtures.

**Figure 8**

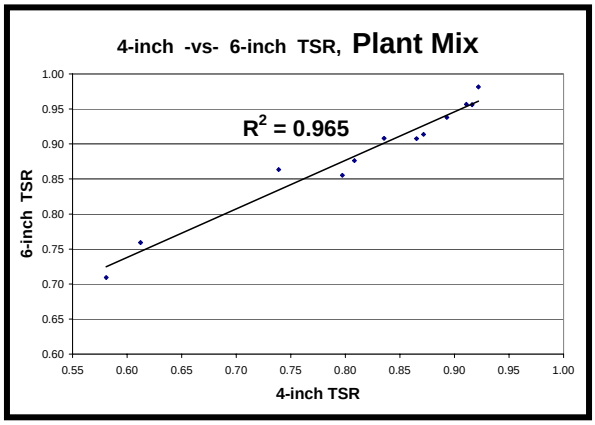
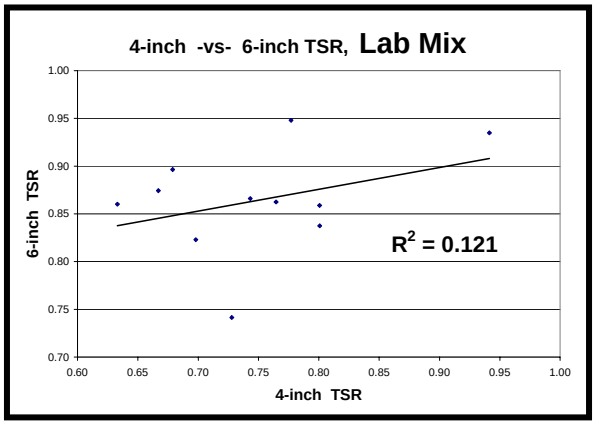



**Figure 9**



## Visual Strip Ratings

The average visual strip rating of the specimens from the six lab-produced mixtures is given in **Table 5**. All the specimens with no conditioning had a strip rating of "1.0" for both the coarse and the fine aggregates. The ratings for the specimens conditioned in the 140°F water bath ranged from 1.0 to a 3.0, depending on the specific mixture. The rating for the 6-inch diameter specimens was either the same as, or less than, the rating for the 4-inch specimens, for both the coarse and the fine aggregates that were conditioned in the 140°F water bath.

**Table 5**

**STRIP RATING**

| | | No Conditioning | | 140 Bath | |
|---|---|---|---|---|---|
| **Mix Number** | **Sample Size** | **Coarse** | **Fine** | **Coarse** | **Fine** |
| **Chert** | **4-inch** | 1.0 | 1.0 | 2.7 | 2.2 |
| **Chert** | **6-inch** | 1.0 | 1.0 | 2.7 | 2.0 |
| | | | | | |
| **038 Re** | **6-inch** | 1.0 | 1.0 | 1.0 | 1.0 |
| | | | | | |
| **033A** | **4-inch** | 1.0 | 1.0 | 2.0 | 2.0 |
| **033A** | **6-inch** | 1.0 | 1.0 | 2.0 | 2.0 |
| | | | | | |
| **033B** | **4-inch** | 1.0 | 1.0 | 2.0 | 2.0 |
| **033B** | **6-inch** | 1.0 | 1.0 | 1.0 | 1.0 |
| | | | | | |
| **229** | **4-inch** | 1.0 | 1.0 | 2.0 | 2.0 |
| **229** | **6-inch** | 1.0 | 1.0 | 2.0 | 2.0 |

## Inconsistencies in the Relationship Between Tensile Strength and TSR

It is common knowledge that high strengths do not always ensure a high TSR, and that a passing TSR often results from low initial strengths. Also, mixture additives meant to improve the TSR sometimes do so at the cost of lowering the unconditioned strength rather than raising the conditioned strength.

One of the criteria for mix design selection for this study was a low, but passing, TSR value. Most of the specimens in this study had a tensile strength of 60 psi or greater. A design strength of 60 psi is generally regarded as being on the low side of acceptable. This value was selected, somewhat arbitrarily for comparison purposes, as the criteria between an acceptable and an unacceptable strength.

**Table 6** shows a summary of the average unconditioned and conditioned tensile strengths and the TSRs of all the plant-produced mixtures and the lab-produced mixtures. Inconsistencies in the relationship between tensile strength and TSR are also shown in **Table 6**. In this summary, there are twelve strength and TSR pairs for each of the two sample sizes for the plant-produced mixtures and there are eleven strength and TSR pairs for each of the two sample sizes for the lab-produced mixtures, for a total of 46 pairs. Eight of the pairs have both the unconditioned and the conditioned strengths greater than 60 psi (some well over 100 psi) but still have a TSR that is less than the 0.75 criteria in Illinois. Three of the pairs have both unconditioned and conditioned strengths that are less than 60 psi and still have a TSR that is over 0.80. It is possible, if not common, to have a passing TSR but to have low strengths. Only three of the pairs have tensile strengths less than 60 psi and a TSR less than the 0.75 criteria.

**Table 6**

**4-inch -vs- 6-inch TSR Inconsistency**

| | 4-inch Plant | | | 4-inch Lab | | | 6-inch Plant | | | 6-inch Lab | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Strength (psi) | | TSR | Strength (psi) | | TSR | Strength (psi) | | TSR | Strength (psi) | | TSR |
| Mix ID & District | Uncond | Cond | | Uncond | Cond | | Uncond | Cond | | Uncond | Cond | |
| 021 District 4 | 110.2 | 101.0 | 0.916 | 99.2 | 93.4 | 0.941 | 80.5 | 77.0 | 0.956 | 70.4 | 65.8 | 0.935 |
| **022 District 4** | 146.2 | 134.8 | 0.922 | ***136.6*** | ***86.5*** | ***0.633*** | 108.7 | 106.7 | 0.981 | 105.4 | 90.7 | 0.860 |
| 023 District 8 | 151.6 | 126.7 | 0.836 | ***130.4*** | ***96.9*** | ***0.743*** | 128.5 | 116.7 | 0.908 | 110.0 | 95.2 | 0.866 |
| 025 District 2 | 169.1 | 136.7 | 0.808 | 117.3 | 89.7 | 0.765 | 130.4 | 114.3 | 0.876 | 84.8 | 73.2 | 0.862 |
| 027 District 5 | 173.5 | 151.2 | 0.872 | ***135.6*** | ***92.0*** | ***0.679*** | 128.5 | 117.4 | 0.914 | 88.8 | 79.6 | 0.896 |
| **033A District 9** | ***191.0*** | ***141.1*** | ***0.739*** | **53.0** | **42.5** | **0.801** | 155.1 | 133.9 | 0.863 | **51.6** | **43.2** | **0.838** |
| **033B District 9** | ***197.1*** | ***120.7*** | ***0.612*** | **54.5** | **38.1** | **0.698** | 165.5 | 125.7 | 0.759 | **50.1** | **41.2** | **0.823** |
| **038 District 6** | ***167.4*** | ***97.2*** | ***0.581*** | 101.9 | 79.2 | 0.777 | ***123.3*** | ***87.5*** | ***0.709*** | 64.8 | 61.4 | 0.948 |
| 229 District 7 | 153.3 | 122.2 | 0.797 | 101.1 | 80.9 | 0.801 | 125.7 | 107.5 | 0.855 | 81.6 | 70.1 | 0.859 |
| **230 District 3** | 153.6 | 132.9 | 0.865 | ***111.0*** | ***74.0*** | ***0.667*** | 122.6 | 111.3 | 0.908 | 79.3 | 69.3 | 0.874 |
| 231 District 5 | 131.9 | 117.8 | 0.893 | | | | 90.5 | 84.9 | 0.938 | | | |
| 232 District 7 | 152.0 | 138.5 | 0.911 | | | | 106.5 | 101.9 | 0.957 | | | |
| **District 8 Chert** | | | | **81.6** | **59.4** | **0.728** | | | | **68.8** | **51.0** | **0.742** |

| | |
|---|---|
| XXX | Strength less than 60 psi & Passing 0.75 TSR Criteria |
| *XXX* | Both Strengths greater than 60 psi & Failing 0.75 TSR Criteria |
| XXX | At least one Strength less than 60 psi and Failing 0.75 TSR Criteria |

# CONCLUSIONS AND RECOMMENDATIONS

## *Conclusions*

1. The average tensile strength of specimens made from plant-produced mixtures was significantly greater than the average tensile strengths of the same mixture produced in the lab.
2. The average tensile strength of unconditioned specimens was greater than the average tensile strength from comparable specimens conditioned in the 140°F water bath.
3. The average tensile strength of 4-inch diameter specimens was larger than the average tensile strength of 6-inch specimens.
4. There was a consistent trend between the average tensile strength from 4-inch unconditioned specimens and the average tensile strengths from the 6-inch specimens, both unconditioned and conditioned. The tensile strength from the 4-inch conditioned specimens was more variable and did not closely follow the pattern of the other three groups. This was true for both plant-produced mix and lab-produced mix.

5. When comparing the plant-produced mix and the lab-produced mix from the same design, the TSRs for the 6-inch specimens were reasonably similar. For the 4-inch specimens, there was a greater difference between the TSRs from the same design when comparing the plant-produced and lab-produced mixture.
6. The TSRs from 6-inch specimens were larger than the TSRs from 4-inch specimens for all the plant-produced mixes by an average of 0.073. The TSRs from 6-inch specimens were larger than the TSRs from 4-inch specimens by an average of 0.115. Also, the difference between the TSRs from the two specimen sizes was considerably more consistent in the plant-produced mixes than the lab-produced mixes.
7. Using 6-inch specimens may result in more consistency of TSR results, based on the variability in the tensile strengths of the 4-inch conditioned specimens.
8. Although conducted only on the last several mixtures tested, the visual strip rating provides a subjective evaluation of the degree of actual moisture damage present in the split specimens.

### *Recommendations*

1. This study indicated that the TSR from 6-inch specimens is larger than the TSR from 4-inch specimens. Based on these results, a TSR criterion of 0.85 is recommended when testing 6-inch diameter by 3 ¾-inch (95-mm) high gyratory specimens.
2. Since the TSR alone is not always a conclusive means of evaluating the moisture susceptibility of a mixture, considering a minimum tensile strength of 60 psi, in addition to the TSR criteria, is recommended for all specimens.

## REFERENCES


1. "Standard Specifications for Transportation Materials and Methods of Sampling and Testing," *Part 2B: Tests*, 22nd Edition, American Association of State Highway and Transportation Officials, 2002.

2. Epps, J.A., P.E. Sebaaly, J. Penaranda, M.R. Maher, M.B. McCann, and A.J. Hand, NCHRP *Report 444: Compatibility of a Test for Moisture-Induced Damage with Superpave Volumetric Mix Design*. Transportation Research Board, National Research Council, Washington, D.C., 2000.

# APPENDIX

## 4-inch -vs- 6-inch TSR Study

| Date Data Entered | 11/13/2000 |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **021** |
| **District Number** | District 4 |
| **Mix Design Number** | 84BIT005S |
| **Material Code** | 19515M |
| **Type Mix** | Surface, N50, E mix |
| **District Gmm** | 2.675 |
| **Producer** | Freesen, Inc. |
| **P/S Number** | 701-17 |
| **Location** | Peoria |
| **Contract Number** | |
| **Date Sampled** | |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | 50 |
| **Nominal Maximum Size** | 9.5 mm |
| **Coarse Aggregate #1** | 039CMM13 |
| **Name of Coarse #1** | Steel Slag |
| **% of Coarse #1** | 36.0 |
| **Coarse Aggregate #2** | 031CMM13 |
| **Name of Coarse #2** | Crushed Gravel |
| **% of Coarse #2** | 32.5 |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 039FAM20 |
| **Name Fine #1** | Steel Slag |
| **% Fine #1** | 10.0 |
| **Fine Aggregate #2** | 037FAM01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 18.0 |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone |
| **% of MF** | 3.5 |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.6 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.85 |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **021** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.481 | 2.484 | 2.472 | 2.473 | 2.495 | 2.490 | 2.488 | 2.489 |
| **Gmb, Standard Deviation** | 0.0079 | 0.0075 | 0.0065 | 0.0063 | 0.0151 | 0.0102 | 0.0069 | 0.0076 |
| **Gmb, Maximum** | 2.490 | 2.491 | 2.480 | 2.481 | 2.516 | 2.504 | 2.497 | 2.497 |
| **Gmb, Minimum** | 2.472 | 2.471 | 2.462 | 2.464 | 2.478 | 2.477 | 2.476 | 2.475 |
| **Gmb, Range** | 0.018 | 0.020 | 0.018 | 0.017 | 0.038 | 0.027 | 0.021 | 0.022 |
| **Gmb, Average, Set A & B** | 2.482 | | 2.473 | | 2.492 | | 2.489 | |
| **Gmb, STDEV, Set A & B** | 0.0074 | | 0.0061 | | 0.0125 | | 0.0069 | |
| **Gmb, Maximum, Set A & B** | 2.491 | | 2.481 | | 2.516 | | 2.497 | |
| **Gmb, Minimum, Set A & B** | 2.471 | | 2.462 | | 2.477 | | 2.475 | |
| **Gmb, Range Set, A & B** | 0.020 | | 0.019 | | 0.039 | | 0.022 | |
| **Voids, Average** | 7.0 | 7.0 | 7.4 | 7.3 | 7.1 | 7.2 | 7.3 | 7.3 |
| **Voids, Standard Deviation** | 0.32 | 0.27 | 0.25 | 0.25 | 0.56 | 0.39 | 0.23 | 0.28 |
| **Voids, Maximum** | 7.4 | 7.4 | 7.8 | 7.7 | 7.7 | 7.7 | 7.7 | 7.8 |
| **Voids, Minimum** | 6.7 | 6.7 | 7.1 | 7.0 | 6.3 | 6.7 | 7.0 | 7.0 |
| **Voids, Range** | 0.7 | 0.7 | 0.7 | 0.7 | 1.4 | 1.0 | 0.7 | 0.8 |
| **Voids, Average Set A & B** | 7.0 | | 7.4 | | 7.1 | | 7.3 | |
| **Voids, STDEV, Set A & B** | 0.28 | | 0.24 | | 0.47 | | 0.24 | |
| **Voids, Maximum, Set A & B** | 7.4 | | 7.8 | | 7.7 | | 7.8 | |
| **Voids, Minimun, Set & B** | 6.7 | | 7.0 | | 6.3 | | 7.0 | |
| **Voids, Range, Set A & B** | 0.7 | | 0.8 | | 1.4 | | 0.8 | |
| **% Saturation, Average** | 70.7 | 69.6 | 71.1 | 70.9 | 70.7 | 69.6 | 69.6 | 70.5 |
| **% Saturation, STDEV** | 1.4 | 1.2 | 0.2 | 0.6 | 0.1 | 1.2 | 1.1 | 0.4 |
| **% Saturation, Maximum** | 71.8 | 70.8 | 71.3 | 71.4 | 70.8 | 71.0 | 70.6 | 70.8 |
| **% Saturation, Minimum** | 69.1 | 68.5 | 70.9 | 70.3 | 70.6 | 68.7 | 68.4 | 70.1 |
| **% Saturation, Range** | 2.7 | 2.3 | 0.4 | 1.1 | 0.2 | 2.3 | 2.2 | 0.7 |
| **% Sat, Avg, Set A & B** | 70.2 | | 71.0 | | 70.1 | | 70.1 | |
| **% Sat, STDEV, Set A & B** | 1.3 | | 0.4 | | 1.0 | | 0.9 | |
| **% Sat, Maximum, Set A & B** | 71.8 | | 71.4 | | 71.0 | | 70.8 | |
| **% Sat, Minimum, Set A & B** | 68.5 | | 70.3 | | 68.7 | | 68.4 | |
| **% Sat, Range, Set A & B** | 3.3 | | 1.1 | | 2.3 | | 2.4 | |
| **Uncond Strength, Average** | 110.6 | 109.8 | 75.9 | 85.1 | 94.4 | 104.0 | 71.9 | 68.8 |
| **Uncond Strength, STDEV** | 9.4 | 1.6 | 1.6 | 4.8 | 7.6 | 13.6 | 3.9 | 3.3 |
| **Uncond Strength, MAX** | 121.0 | 111.4 | 77.8 | 90.5 | 100.3 | 119.4 | 76.4 | 71.4 |
| **Uncond Strength, MIN** | 102.7 | 108.2 | 75.0 | 81.3 | 85.9 | 93.9 | 69.3 | 65.1 |
| **Uncond Strength, Range** | 18.3 | 3.2 | 2.8 | 9.2 | 14.4 | 25.5 | 7.1 | 6.3 |
| **Uncond Str, Avg, Set A & B** | 110.2 | | 80.5 | | 99.2 | | 70.4 | |
| **Unc Str, STDEV, Set A & B** | 6.0 | | 6.0 | | 11.1 | | 3.7 | |
| **Uncnd Str, MAX, Set A & B** | 121.0 | | 90.5 | | 119.4 | | 76.4 | |
| **Uncnd Str, MIN, Set A & B** | 102.7 | | 75.0 | | 85.9 | | 65.1 | |
| **Unc Str, Range, Set A & B** | 18.3 | | 15.5 | | 33.5 | | 11.3 | |
| **Cond Strength, Average** | 104.9 | 97.1 | 75.9 | 78.0 | 87.0 | 99.8 | 62.7 | 68.8 |
| **Cond Strength, STDEV** | 6.1 | 9.7 | 3.6 | 2.0 | 10.6 | 3.7 | 3.0 | 8.7 |
| **Cond Strength, MAX** | 110.9 | 103.5 | 79.9 | 79.2 | 98.7 | 101.9 | 65.1 | 76.4 |
| **Cond Strength, MIN** | 98.7 | 85.9 | 72.9 | 75.7 | 78.0 | 95.5 | 59.4 | 59.4 |
| **Cond Strength, Range** | 12.2 | 17.6 | 7.0 | 3.5 | 20.7 | 6.4 | 5.7 | 17.0 |
| **Cond Str, Avg, Set A & B** | 101.0 | | 77.0 | | 93.4 | | 65.8 | |
| **Cond Str, STDEV, Set A & B** | 8.4 | | 2.8 | | 10.0 | | 6.7 | |
| **Cond Str, MAX, Set A & B** | 110.9 | | 79.9 | | 101.9 | | 76.4 | |
| **Cond Str, MIN, Set A & B** | 85.9 | | 72.9 | | 78.0 | | 59.4 | |
| **Cond Str, Range, Set A & B** | 25.0 | | 7.0 | | 23.9 | | 17.0 | |
| **TSR** | 0.948 | 0.884 | 1.000 | 0.917 | 0.922 | 0.959 | 0.873 | 1.000 |
| **TSR, Set A & B** | 0.916 | | 0.956 | | 0.941 | | 0.935 | |
| TSR DIFFERENCE, 6" - 4" | 0.040 | | | | -0.007 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | 11/13/2000 |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **022** |
| **District Number** | District 4 |
| **Mix Design Number** | 84BIT061S |
| **Material Code** | 19552M |
| **Type Mix** | Binder, N70 |
| **District Gmm** | 2.528 |
| **Producer** | R.A. Cullinan |
| **P/S Number** | 475-31 |
| **Location** | Peoria |
| **Contract Number** | |
| **Date Sampled** | |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N70 |
| **Nominal Maximum Size** | 19.0 mm |
| **Coarse Aggregate #1** | 042CMM11 |
| **Name of Coarse #1** | Dolomite |
| **% of Coarse #1** | 41.1 |
| **Coarse Aggregate #2** | 032CMM16 |
| **Name of Coarse #2** | Dolomite |
| **% of Coarse #2** | 32.0 |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 037FAM01 |
| **Name Fine #1** | Natural Sand |
| **% Fine #1** | 15.0 |
| **Fine Aggregate #2** | 039FAM20 |
| **Name Fine #2** | Steel Slag |
| **% Fine #2** | 10.0 |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone |
| **% of MF** | 1.9 |
| **AC Grade** | PG 64-22 |
| **% AC** | 4.6 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **022** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.390 | 2.370 | 2.376 | 2.373 | 2.343 | 2.343 | 2.360 | 2.346 |
| **Gmb, Sample 2** | 2.395 | 2.377 | 2.375 | 2.366 | 2.348 | 2.359 | 2.350 | 2.347 |
| **Gmb, Sample 3** | 2.393 | 2.386 | 2.372 | 2.373 | 2.353 | 2.346 | 2.351 | 2.361 |
| **Gmb, Sample 4** | 2.390 | 2.388 | 2.372 | 2.372 | 2.338 | 2.347 | 2.345 | 2.353 |
| **Gmb, Sample 5** | 2.384 | 2.380 | 2.372 | 2.370 | 2.358 | 2.359 | 2.353 | 2.350 |
| **Gmb, Sample 6** | 2.390 | 2.389 | 2.380 | 2.374 | 2.354 | 2.357 | 2.348 | 2.351 |
| **Gmb, Average** | **2.390** | **2.382** | **2.375** | **2.371** | **2.349** | **2.352** | **2.351** | **2.351** |
| **Gmb, Average Set A & B** | **2.386** | | **2.373** | | **2.350** | | **2.351** | |
| **BMPR Gmm** | 2.561 | | 2.561 | | 2.536 | | 2.536 | |
| **Voids, Sample 1** | 6.7 | 7.5 | 7.2 | 7.3 | 7.6 | 7.6 | 7.0 | 7.5 |
| **Voids, Sample 2** | 6.5 | 7.2 | 7.3 | 7.6 | 7.4 | 7.0 | 7.3 | 7.5 |
| **Voids, Sample 3** | 6.6 | 6.8 | 7.4 | 7.3 | 7.2 | 7.5 | 7.3 | 6.9 |
| **Voids, Sample 4** | 6.7 | 6.8 | 7.4 | 7.1 | 7.8 | 7.5 | 7.5 | 7.2 |
| **Voids, Sample 5** | 6.9 | 7.1 | 7.4 | 7.5 | 7.0 | 7.0 | 7.2 | 7.3 |
| **Voids, Sample 6** | 6.7 | 6.7 | 7.1 | 7.3 | 7.2 | 7.1 | 7.4 | 7.3 |
| **Voids, Average** | **6.7** | **7.0** | **7.3** | **7.4** | **7.4** | **7.3** | **7.3** | **7.3** |
| **Voids, Average Set A & B** | **6.9** | | **7.3** | | **7.3** | | **7.3** | |
| **% Saturated, Sample 1** | | 69.2 | | 70.9 | | 70.3 | 71.0 | 71.1 |
| **% Saturated, Sample 2** | 69.4 | | | 70.7 | | 71.2 | | 70.4 |
| **% Saturated, Sample 3** | | 70.9 | 71.6 | 70.6 | 70.2 | 68.7 | | 70.0 |
| **% Saturated, Sample 4** | 68.6 | | 69.0 | | 69.4 | | 68.6 | |
| **% Saturated, Sample 5** | 68.6 | | | | 70.1 | | | |
| **% Saturated, Sample 6** | | 68.3 | 70.2 | | | | 68.1 | |
| **Average % Saturation** | **68.9** | **69.5** | **70.3** | **70.7** | **69.9** | **70.1** | **69.2** | **70.5** |
| **Avg. % Sat. Set A & B** | **69.2** | | **70.5** | | **70.0** | | **69.9** | |
| **Cond or Uncond, Sample 1** | Uncond | Cond | Uncond | Cond | Uncond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 2** | Cond | Uncond | Uncond | Cond | Uncond | Cond | Uncond | Cond |
| **Cond or Uncond, Sample 3** | Uncond | Cond | Cond | Cond | Cond | Cond | Uncond | Cond |
| **Cond or Uncond, Sample 4** | Cond | Uncond | Cond | Uncond | Cond | Uncond | Cond | Uncond |
| **Cond or Uncond, Sample 5** | Cond | Uncond | Uncond | Uncond | Cond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | Uncond | Cond | Cond | Uncond | Uncond | Uncond | Cond | Uncond |
| **Uncond Strength, Sample 1** | 140.2 | | 104.0 | | 121.0 | | | |
| **Cond Strength, Sample 1** | | 117.8 | | 112.5 | | 89.1 | 89.1 | 79.9 |
| **Uncond Strength, Sample 2** | | 136.9 | 104.0 | | 140.1 | | 100.4 | |
| **Cond Strength, Sample 2** | 133.7 | | | 108.9 | | 84.4 | | 96.2 |
| **Uncond Strength, Sample 3** | 150.0 | | | | | | 110.3 | |
| **Cond Strength, Sample 3** | | 133.7 | 96.9 | 116.7 | 98.7 | 76.4 | | 94.8 |
| **Uncond Strength, Sample 4** | | 150.0 | | 114.6 | | 136.9 | | 103.3 |
| **Cond Strength, Sample 4** | 152.8 | | 104.0 | | 82.8 | | 95.5 | |
| **Uncond Strength, Sample 5** | | 150.0 | 104.0 | 113.9 | | 146.4 | 108.9 | 101.9 |
| **Cond Strength, Sample 5** | 137.0 | | | | 87.5 | | | |
| **Uncond Strength, Sample 6** | 150.0 | | | 111.8 | 140.0 | 135.3 | | 107.5 |
| **Cond Strength, Sample 6** | | 133.7 | 101.2 | | | | 88.4 | |
| **Average Uncond Strength** | **146.7** | **145.6** | **104.0** | **113.4** | **133.7** | **139.5** | **106.5** | **104.2** |
| **Avg Uncond Str., Set A & B** | **146.2** | | **108.7** | | **136.6** | | **105.4** | |
| **Average Cond Strength** | **141.2** | **128.4** | **100.7** | **112.7** | **89.7** | **83.3** | **91.0** | **90.3** |
| **Avg Cond Str., Set A & B** | **134.8** | | **106.7** | | **86.5** | | **90.7** | |
| **Avg Uncond Str. w/Additive** | | | | | 133.7 | 139.5 | 106.5 | 104.2 |
| **Avg Cond Str. w/Additive** | | | | | 89.7 | 83.3 | 91.0 | 90.3 |
| **TSR** | **0.962** | **0.882** | **0.968** | **0.994** | **0.671** | **0.597** | **0.854** | **0.866** |
| **TSR, Set A & B** | **0.922** | | **0.981** | | **0.633** | | **0.860** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **022** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.390 | 2.382 | 2.375 | 2.371 | 2.349 | 2.352 | 2.351 | 2.351 |
| **Gmb, Standard Deviation** | 0.0037 | 0.0074 | 0.0032 | 0.0029 | 0.0075 | 0.0073 | 0.0051 | 0.0054 |
| **Gmb, Maximum** | 2.395 | 2.389 | 2.380 | 2.374 | 2.358 | 2.359 | 2.360 | 2.361 |
| **Gmb, Minimum** | 2.384 | 2.370 | 2.372 | 2.366 | 2.338 | 2.343 | 2.345 | 2.346 |
| **Gmb, Range** | 0.011 | 0.019 | 0.008 | 0.008 | 0.020 | 0.016 | 0.015 | 0.015 |
| **Gmb, Average, Set A & B** | 2.386 | | 2.373 | | 2.350 | | 2.351 | |
| **Gmb, STDEV, Set A & B** | 0.0072 | | 0.0034 | | 0.0072 | | 0.0050 | |
| **Gmb, Maximum, Set A & B** | 2.395 | | 2.380 | | 2.359 | | 2.361 | |
| **Gmb, Minimum, Set A & B** | 2.370 | | 2.366 | | 2.338 | | 2.345 | |
| **Gmb, Range Set, A & B** | 0.025 | | 0.014 | | 0.021 | | 0.016 | |
| **Voids, Average** | 6.7 | 7.0 | 7.3 | 7.4 | 7.4 | 7.3 | 7.3 | 7.3 |
| **Voids, Standard Deviation** | 0.13 | 0.31 | 0.13 | 0.18 | 0.29 | 0.28 | 0.17 | 0.22 |
| **Voids, Maximum** | 6.9 | 7.5 | 7.4 | 7.6 | 7.8 | 7.6 | 7.5 | 7.5 |
| **Voids, Minimum** | 6.5 | 6.7 | 7.1 | 7.1 | 7.0 | 7.0 | 7.0 | 6.9 |
| **Voids, Range** | 0.4 | 0.8 | 0.3 | 0.5 | 0.8 | 0.6 | 0.5 | 0.6 |
| **Voids, Average Set A & B** | 6.9 | | 7.3 | | 7.3 | | 7.3 | |
| **Voids, STDEV, Set A & B** | 0.28 | | 0.15 | | 0.28 | | 0.19 | |
| **Voids, Maximum, Set A & B** | 7.5 | | 7.6 | | 7.8 | | 7.5 | |
| **Voids, Minimun, Set & B** | 6.5 | | 7.1 | | 7.0 | | 6.9 | |
| **Voids, Range, Set A & B** | 1.0 | | 0.5 | | 0.8 | | 0.6 | |
| **% Saturation, Average** | 68.9 | 69.5 | 70.3 | 70.7 | 69.9 | 70.1 | 69.2 | 70.5 |
| **% Saturation, STDEV** | 0.5 | 1.3 | 1.3 | 0.2 | 0.4 | 1.3 | 1.6 | 0.6 |
| **% Saturation, Maximum** | 69.4 | 70.9 | 71.6 | 70.9 | 70.2 | 71.2 | 71.0 | 71.1 |
| **% Saturation, Minimum** | 68.6 | 68.3 | 69.0 | 70.6 | 69.4 | 68.7 | 68.1 | 70.0 |
| **% Saturation, Range** | 0.8 | 2.6 | 2.6 | 0.3 | 0.8 | 2.5 | 2.9 | 1.1 |
| **% Sat, Avg, Set A & B** | 69.2 | | 70.5 | | 70.0 | | 69.9 | |
| **% Sat, STDEV, Set A & B** | 0.9 | | 0.9 | | 0.9 | | 1.3 | |
| **% Sat, Maximum, Set A & B** | 70.9 | | 71.6 | | 71.2 | | 71.1 | |
| **% Sat, Minimum, Set A & B** | 68.3 | | 69.0 | | 68.7 | | 68.1 | |
| **% Sat, Range, Set A & B** | 2.6 | | 2.6 | | 2.5 | | 3.0 | |
| **Uncond Strength, Average** | 146.7 | 145.6 | 104.0 | 113.4 | 133.7 | 139.5 | 106.5 | 104.2 |
| **Uncond Strength, STDEV** | 5.7 | 7.6 | 0.0 | 1.5 | 11.0 | 6.0 | 5.4 | 2.9 |
| **Uncond Strength, MAX** | 150.0 | 150.0 | 104.0 | 114.6 | 140.1 | 146.4 | 110.3 | 107.5 |
| **Uncond Strength, MIN** | 140.2 | 136.9 | 104.0 | 111.8 | 121.0 | 135.3 | 100.4 | 101.9 |
| **Uncond Strength, Range** | 9.8 | 13.1 | 0.0 | 2.8 | 19.1 | 11.1 | 9.9 | 5.6 |
| **Uncond Str, Avg, Set A & B** | 146.2 | | 108.7 | | 136.6 | | 105.4 | |
| **Unc Str, STDEV, Set A & B** | 6.0 | | 5.2 | | 8.5 | | 4.1 | |
| **Uncnd Str, MAX, Set A & B** | 150.0 | | 114.6 | | 146.4 | | 110.3 | |
| **Uncnd Str, MIN, Set A & B** | 136.9 | | 104.0 | | 121.0 | | 100.4 | |
| **Unc Str, Range, Set A & B** | 13.1 | | 10.6 | | 25.4 | | 9.9 | |
| **Cond Strength, Average** | 141.2 | 128.4 | 100.7 | 112.7 | 89.7 | 83.3 | 91.0 | 90.3 |
| **Cond Strength, STDEV** | 10.2 | 9.2 | 3.6 | 3.9 | 8.2 | 6.4 | 3.9 | 9.0 |
| **Cond Strength, MAX** | 152.8 | 133.7 | 104.0 | 116.7 | 98.7 | 89.1 | 95.5 | 96.2 |
| **Cond Strength, MIN** | 133.7 | 117.8 | 96.9 | 108.9 | 82.8 | 76.4 | 88.4 | 79.9 |
| **Cond Strength, Range** | 19.1 | 15.9 | 7.1 | 7.8 | 15.9 | 12.7 | 7.1 | 16.3 |
| **Cond Str, Avg, Set A & B** | 134.8 | | 106.7 | | 86.5 | | 90.7 | |
| **Cond Str, STDEV, Set A & B** | 11.1 | | 7.4 | | 7.4 | | 6.2 | |
| **Cond Str, MAX, Set A & B** | 152.8 | | 116.7 | | 98.7 | | 96.2 | |
| **Cond Str, MIN, Set A & B** | 117.8 | | 96.9 | | 76.4 | | 79.9 | |
| **Cond Str, Range, Set A & B** | 35.0 | | 19.8 | | 22.3 | | 16.3 | |
| **TSR** | 0.962 | 0.882 | 0.968 | 0.994 | 0.671 | 0.597 | 0.854 | 0.866 |
| **TSR, Set A & B** | 0.922 | | 0.981 | | 0.633 | | 0.860 | |
| TSR DIFFERENCE, 6" - 4" | 0.059 | | | | 0.227 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | 11/27/2000 |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **023** |
| **District Number** | District 8 |
| **Mix Design Number** | 88Bit1783 |
| **Material Code** | 17565 |
| **Type Mix** | BitConc SCS Type 2 E |
| **District Gmm** | 2.415 |
| **Producer** | Maclair Asphalt Company |
| **P/S Number** | 1202-07 |
| **Location** | State Park |
| **Contract Number** | |
| **Date Sampled** | 27-Jun-00 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | 50 Blow Marshall |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 033CMM13 |
| **Name of Coarse #1** | ACBF Slag |
| **% of Coarse #1** | 30.0 |
| **Coarse Aggregate #2** | 032CMM13 |
| **Name of Coarse #2** | Crushed Limestone |
| **% of Coarse #2** | 33.0 |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FAM20 |
| **Name Fine #1** | Crushed Limestone Sand |
| **% Fine #1** | 23.2 |
| **Fine Aggregate #2** | 037FAM01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 9.3 |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 4.5 |
| **AC Grade** | PG 70-22 SBS Polymer |
| **% AC** | 6.1 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.88 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **023** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.239 | 2.255 | 2.248 | 2.248 | 2.237 | 2.240 | 2.230 | 2.233 |
| **Gmb, Sample 2** | 2.243 | 2.236 | 2.257 | 2.245 | 2.215 | 2.238 | 2.207 | 2.226 |
| **Gmb, Sample 3** | 2.247 | 2.259 | 2.246 | 2.249 | 2.228 | 2.233 | 2.230 | 2.227 |
| **Gmb, Sample 4** | 2.248 | 2.241 | 2.252 | 2.251 | 2.239 | 2.228 | 2.235 | 2.233 |
| **Gmb, Sample 5** | 2.248 | 2.240 | 2.245 | 2.249 | 2.238 | 2.232 | 2.240 | 2.221 |
| **Gmb, Sample 6** | 2.249 | 2.255 | 2.248 | 2.248 | 2.229 | 2.233 | 2.234 | 2.229 |
| **Gmb, Average** | **2.246** | **2.248** | **2.249** | **2.248** | **2.231** | **2.234** | **2.229** | **2.228** |
| **Gmb, Average Set A & B** | **2.247** | | **2.249** | | **2.233** | | **2.229** | |
| **BMPR Gmm** | 2.416 | | 2.416 | | 2.395 | | 2.395 | |
| **Voids, Sample 1** | 7.3 | 6.7 | 7.0 | 7.0 | 6.6 | 6.5 | 6.9 | 6.8 |
| **Voids, Sample 2** | 7.2 | 7.5 | 6.6 | 7.1 | 7.5 | 6.6 | 7.8 | 7.1 |
| **Voids, Sample 3** | 7.0 | 6.5 | 7.0 | 6.9 | 7.0 | 6.8 | 6.9 | 7.0 |
| **Voids, Sample 4** | 7.0 | 7.2 | 6.8 | 6.8 | 6.5 | 7.0 | 6.7 | 6.8 |
| **Voids, Sample 5** | 7.0 | 7.3 | 7.1 | 6.9 | 6.6 | 6.8 | 6.5 | 7.3 |
| **Voids, Sample 6** | 6.9 | 6.7 | 7.0 | 7.0 | 6.9 | 6.8 | 6.7 | 6.9 |
| **Voids, Average** | **7.1** | **7.0** | **6.9** | **7.0** | **6.9** | **6.8** | **6.9** | **7.0** |
| **Voids, Average Set A & B** | **7.0** | | **6.9** | | **6.8** | | **7.0** | |
| **% Saturated, Sample 1** | 71.6 | | 71.2 | | | 71.1 | 71.5 | |
| **% Saturated, Sample 2** | | | 70.5 | 68.8 | 71.4 | | | 71.8 |
| **% Saturated, Sample 3** | | 69.5 | | | | | 71.4 | 70.8 |
| **% Saturated, Sample 4** | | 69.5 | | 70.8 | 71.7 | 70.6 | | |
| **% Saturated, Sample 5** | 70.7 | 69.4 | 68.8 | | 70.4 | 71.1 | | |
| **% Saturated, Sample 6** | 70.1 | | | 68.5 | | | 71.9 | 68.6 |
| **Average % Saturation** | **70.8** | **69.5** | **70.2** | **69.4** | **71.2** | **70.9** | **71.6** | **70.4** |
| **Avg. % Sat. Set A & B** | **70.1** | | **69.8** | | **71.1** | | **71.0** | |
| **Cond or Uncond, Sample 1** | Cond | Uncond | Cond | Uncond | Uncond | Cond | Cond | Uncond |
| **Cond or Uncond, Sample 2** | Uncond | Uncond | Cond | Cond | Cond | Uncond | Uncond | Cond |
| **Cond or Uncond, Sample 3** | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | Cond | Cond |
| **Cond or Uncond, Sample 4** | Uncond | Cond | Uncond | Cond | Cond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Cond | Cond | Cond | Uncond | Cond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | Cond | Uncond | Uncond | Cond | Uncond | Uncond | Cond | Cond |
| **Uncond Strength, Sample 1** | | 158.5 | | 131.6 | 133.5 | | | 106.8 |
| **Cond Strength, Sample 1** | 122.8 | | 118.8 | | | 102.5 | 99.0 | |
| **Uncond Strength, Sample 2** | 143.0 | 152.3 | | | | 124.2 | 114.5 | |
| **Cond Strength, Sample 2** | | | 114.6 | 116.0 | 97.0 | | | 93.4 |
| **Uncond Strength, Sample 3** | 148.1 | | 125.9 | 130.2 | 122.7 | 136.6 | | |
| **Cond Strength, Sample 3** | | 138.4 | | | | | 92.0 | 94.7 |
| **Uncond Strength, Sample 4** | 149.2 | | 130.2 | | | | 108.2 | 108.2 |
| **Cond Strength, Sample 4** | | 125.9 | | 118.8 | 96.3 | 100.9 | | |
| **Uncond Strength, Sample 5** | | | | 134.4 | | | 115.2 | 106.8 |
| **Cond Strength, Sample 5** | 118.1 | 127.4 | 113.2 | | 87.0 | 97.8 | | |
| **Uncond Strength, Sample 6** | | 158.5 | 118.8 | | 135.1 | 130.4 | | |
| **Cond Strength, Sample 6** | 127.4 | | | 118.8 | | | 96.1 | 96.1 |
| **Average Uncond Strength** | **146.8** | **156.4** | **125.0** | **132.1** | **130.4** | **130.4** | **112.6** | **107.3** |
| **Avg Uncond Str., Set A & B** | **151.6** | | **128.5** | | **130.4** | | **110.0** | |
| **Average Cond Strength** | **122.8** | **130.6** | **115.5** | **117.9** | **93.4** | **100.4** | **95.7** | **94.7** |
| **Avg Cond Str., Set A & B** | **126.7** | | **116.7** | | **96.9** | | **95.2** | |
| **Avg Uncond Str. w/Additive** | | | | | 130.4 | 130.4 | 112.6 | 107.3 |
| **Avg Cond Str. w/Additive** | | | | | 93.4 | 100.4 | 95.7 | 94.7 |
| **TSR** | **0.836** | **0.835** | **0.925** | **0.892** | **0.716** | **0.770** | **0.850** | **0.883** |
| **TSR, Set A & B** | **0.836** | | **0.908** | | **0.743** | | **0.866** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **023** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.246 | 2.248 | 2.249 | 2.248 | 2.231 | 2.234 | 2.229 | 2.228 |
| **Gmb, Standard Deviation** | 0.0039 | 0.0098 | 0.0045 | 0.0020 | 0.0091 | 0.0043 | 0.0116 | 0.0046 |
| **Gmb, Maximum** | 2.249 | 2.259 | 2.257 | 2.251 | 2.239 | 2.240 | 2.240 | 2.233 |
| **Gmb, Minimum** | 2.239 | 2.236 | 2.245 | 2.245 | 2.215 | 2.228 | 2.207 | 2.221 |
| **Gmb, Range** | 0.010 | 0.023 | 0.012 | 0.006 | 0.024 | 0.012 | 0.033 | 0.012 |
| **Gmb, Average, Set A & B** | 2.247 | | 2.249 | | 2.233 | | 2.229 | |
| **Gmb, STDEV, Set A & B** | 0.0072 | | 0.0033 | | 0.0070 | | 0.0084 | |
| **Gmb, Maximum, Set A & B** | 2.259 | | 2.257 | | 2.240 | | 2.240 | |
| **Gmb, Minimum, Set A & B** | 2.236 | | 2.245 | | 2.215 | | 2.207 | |
| **Gmb, Range Set, A & B** | 0.023 | | 0.012 | | 0.025 | | 0.033 | |
| **Voids, Average** | 7.1 | 7.0 | 6.9 | 7.0 | 6.9 | 6.8 | 6.9 | 7.0 |
| **Voids, Standard Deviation** | 0.15 | 0.40 | 0.18 | 0.10 | 0.37 | 0.18 | 0.46 | 0.19 |
| **Voids, Maximum** | 7.3 | 7.5 | 7.1 | 7.1 | 7.5 | 7.0 | 7.8 | 7.3 |
| **Voids, Minimum** | 6.9 | 6.5 | 6.6 | 6.8 | 6.5 | 6.5 | 6.5 | 6.8 |
| **Voids, Range** | 0.4 | 1.0 | 0.5 | 0.3 | 1.0 | 0.5 | 1.3 | 0.5 |
| **Voids, Average Set A & B** | 7.0 | | 6.9 | | 6.8 | | 7.0 | |
| **Voids, STDEV, Set A & B** | 0.29 | | 0.14 | | 0.28 | | 0.34 | |
| **Voids, Maximum, Set A & B** | 7.5 | | 7.1 | | 7.5 | | 7.8 | |
| **Voids, Minimun, Set & B** | 6.5 | | 6.6 | | 6.5 | | 6.5 | |
| **Voids, Range, Set A & B** | 1.0 | | 0.5 | | 1.0 | | 1.3 | |
| **% Saturation, Average** | 70.8 | 69.5 | 70.2 | 69.4 | 71.2 | 70.9 | 71.6 | 70.4 |
| **% Saturation, STDEV** | 0.8 | 0.1 | 1.2 | 1.3 | 0.7 | 0.3 | 0.3 | 1.6 |
| **% Saturation, Maximum** | 71.6 | 69.5 | 71.2 | 70.8 | 71.7 | 71.1 | 71.9 | 71.8 |
| **% Saturation, Minimum** | 70.1 | 69.4 | 68.8 | 68.5 | 70.4 | 70.6 | 71.4 | 68.6 |
| **% Saturation, Range** | 1.5 | 0.1 | 2.4 | 2.3 | 1.3 | 0.5 | 0.5 | 3.2 |
| **% Sat, Avg, Set A & B** | 70.1 | | 69.8 | | 71.1 | | 71.0 | |
| **% Sat, STDEV, Set A & B** | 0.9 | | 1.2 | | 0.5 | | 1.2 | |
| **% Sat, Maximum, Set A & B** | 71.6 | | 71.2 | | 71.7 | | 71.9 | |
| **% Sat, Minimum, Set A & B** | 69.4 | | 68.5 | | 70.4 | | 68.6 | |
| **% Sat, Range, Set A & B** | 2.2 | | 2.7 | | 1.3 | | 3.3 | |
| **Uncond Strength, Average** | 146.8 | 156.4 | 125.0 | 132.1 | 130.4 | 130.4 | 112.6 | 107.3 |
| **Uncond Strength, STDEV** | 3.3 | 3.6 | 5.8 | 2.1 | 6.7 | 6.2 | 3.9 | 0.8 |
| **Uncond Strength, MAX** | 149.2 | 158.5 | 130.2 | 134.4 | 135.1 | 136.6 | 115.2 | 108.2 |
| **Uncond Strength, MIN** | 143.0 | 152.3 | 118.8 | 130.2 | 122.7 | 124.2 | 108.2 | 106.8 |
| **Uncond Strength, Range** | 6.2 | 6.2 | 11.4 | 4.2 | 12.4 | 12.4 | 7.0 | 1.4 |
| **Uncond Str, Avg, Set A & B** | 151.6 | | 128.5 | | 130.4 | | 110.0 | |
| **Unc Str, STDEV, Set A & B** | 6.1 | | 5.5 | | 5.8 | | 3.9 | |
| **Uncnd Str, MAX, Set A & B** | 158.5 | | 134.4 | | 136.6 | | 115.2 | |
| **Uncnd Str, MIN, Set A & B** | 143.0 | | 118.8 | | 122.7 | | 106.8 | |
| **Unc Str, Range, Set A & B** | 15.5 | | 15.6 | | 13.9 | | 8.4 | |
| **Cond Strength, Average** | 122.8 | 130.6 | 115.5 | 117.9 | 93.4 | 100.4 | 95.7 | 94.7 |
| **Cond Strength, STDEV** | 4.7 | 6.8 | 2.9 | 1.6 | 5.6 | 2.4 | 3.5 | 1.4 |
| **Cond Strength, MAX** | 127.4 | 138.4 | 118.8 | 118.8 | 97.0 | 102.5 | 99.0 | 96.1 |
| **Cond Strength, MIN** | 118.1 | 125.9 | 113.2 | 116.0 | 87.0 | 97.8 | 92.0 | 93.4 |
| **Cond Strength, Range** | 9.3 | 12.5 | 5.6 | 2.8 | 10.0 | 4.7 | 7.0 | 2.7 |
| **Cond Str, Avg, Set A & B** | 126.7 | | 116.7 | | 96.9 | | 95.2 | |
| **Cond Str, STDEV, Set A & B** | 6.7 | | 2.5 | | 5.4 | | 2.4 | |
| **Cond Str, MAX, Set A & B** | 138.4 | | 118.8 | | 102.5 | | 99.0 | |
| **Cond Str, MIN, Set A & B** | 118.1 | | 113.2 | | 87.0 | | 92.0 | |
| **Cond Str, Range, Set A & B** | 20.3 | | 5.6 | | 15.5 | | 7.0 | |
| **TSR** | 0.836 | 0.835 | 0.925 | 0.892 | 0.716 | 0.770 | 0.850 | 0.883 |
| **TSR, Set A & B** | 0.836 | | 0.908 | | 0.743 | | 0.866 | |
| TSR DIFFERENCE, 6" - 4" | 0.073 | | | | 0.123 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **025** |
| **District Number** | District 2 |
| **Mix Design Number** | 82BIT2722 |
| **Material Code** | 19514M |
| **Type Mix** | Bit Conc Surface Course N50 Type 2 D |
| **District Gmm** | 2.493 |
| **Producer** | Northwest Illinois Construction Company |
| **P/S Number** | 5478-03 |
| **Location** | Route 30 East of Rock Falls |
| **Contract Number** | 64127 |
| **Date Sampled** | 07/18/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | 50 |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 032CMM13 |
| **Name of Coarse #1** | Crushed Dolomite |
| **% of Coarse #1** | 66.5 (Producing at 69.0 %) |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FAM21 |
| **Name Fine #1** | Crushed Dolomite Sand |
| **% Fine #1** | 10.0 (Producing at 7.0 %) |
| **Fine Aggregate #2** | 039FAM20 |
| **Name Fine #2** | Steel Slag Sand |
| **% Fine #2** | 10.0 (Producing at 10.0 %) |
| **Fine Aggregate #3** | 037FAM01 |
| **Name Fine #3** | Natural Sand |
| **% Fine #3** | 12.0 (Producing at 14.0 %) |
| **Mineral Filler** | 004MFM02 |
| **Name of MF** | Dust Collected |
| **% of MF** | 1.5 (Producing at 0.0 %) |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.5 (Producing at 5.3 %) |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.77 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **025** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.359 | 2.367 | 2.364 | 2.347 | 2.325 | 2.331 | 2.348 | 2.339 |
| **Gmb, Sample 2** | 2.352 | 2.361 | 2.361 | 2.357 | 2.338 | 2.351 | 2.340 | 2.342 |
| **Gmb, Sample 3** | 2.351 | 2.358 | 2.361 | 2.361 | 2.326 | 2.329 | 2.346 | 2.346 |
| **Gmb, Sample 4** | 2.354 | 2.355 | 2.360 | 2.352 | 2.336 | 2.332 | 2.340 | 2.345 |
| **Gmb, Sample 5** | 2.351 | 2.366 | 2.356 | 2.357 | 2.334 | 2.350 | 2.348 | 2.338 |
| **Gmb, Sample 6** | 2.362 | 2.361 | 2.361 | 2.359 | 2.346 | 2.325 | 2.349 | 2.331 |
| **Gmb, Average** | **2.355** | **2.361** | **2.361** | **2.356** | **2.334** | **2.336** | **2.345** | **2.340** |
| **Gmb, Average Set A & B** | **2.358** | | **2.358** | | **2.335** | | **2.343** | |
| **BMPR Gmm** | 2.536 | | 2.536 | | 2.514 | | 2.514 | |
| **Voids, Sample 1** | 7.0 | 6.7 | 6.8 | 7.5 | 7.5 | 7.3 | 6.6 | 7.0 |
| **Voids, Sample 2** | 7.3 | 6.9 | 6.9 | 7.1 | 7.0 | 6.5 | 6.9 | 6.8 |
| **Voids, Sample 3** | 7.3 | 7.0 | 6.9 | 6.9 | 7.5 | 7.4 | 6.7 | 6.7 |
| **Voids, Sample 4** | 7.2 | 7.1 | 6.9 | 7.3 | 7.1 | 7.2 | 6.9 | 6.7 |
| **Voids, Sample 5** | 7.3 | 6.7 | 7.1 | 7.1 | 7.2 | 6.5 | 6.6 | 7.0 |
| **Voids, Sample 6** | 6.9 | 6.9 | 6.9 | 7.0 | 6.7 | 7.5 | 6.6 | 7.3 |
| **Voids, Average** | **7.2** | **6.9** | **6.9** | **7.2** | **7.2** | **7.1** | **6.7** | **6.9** |
| **Voids, Average Set A & B** | **7.0** | | **7.0** | | **7.1** | | **6.8** | |
| **% Saturated, Sample 1** | | 70.4 | 70.0 | | | | 69.2 | 70.8 |
| **% Saturated, Sample 2** | 70.1 | 68.7 | 71.4 | | | 71.3 | 70.2 | 71.4 |
| **% Saturated, Sample 3** | 71.3 | | | | 70.7 | | 70.7 | |
| **% Saturated, Sample 4** | | 69.9 | | 70.3 | | 69.5 | | |
| **% Saturated, Sample 5** | | | 70.6 | 70.2 | 71.2 | | | 70.9 |
| **% Saturated, Sample 6** | 69.3 | | | 69.0 | 70.9 | 71.8 | | |
| **Average % Saturation** | **70.2** | **69.7** | **70.7** | **69.8** | **70.9** | **70.9** | **70.0** | **71.0** |
| **Avg. % Sat. Set A & B** | **70.0** | | **70.3** | | **70.9** | | **70.5** | |
| **Cond or Uncond, Sample 1** | Uncond | Cond | Cond | Uncond | Uncond | Uncond | Cond | Cond |
| **Cond or Uncond, Sample 2** | Cond | Cond | Cond | Uncond | Uncond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 3** | Cond | Uncond | Uncond | Uncond | Cond | Uncond | Cond | Uncond |
| **Cond or Uncond, Sample 4** | Uncond | Cond | Uncond | Cond | Uncond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Uncond | Uncond | Cond | Cond | Cond | Uncond | Uncond | Cond |
| **Cond or Uncond, Sample 6** | Cond | Uncond | Uncond | Cond | Cond | Cond | Uncond | Uncond |
| **Uncond Strength, Sample 1** | 165.5 | | | 125.2 | 111.4 | 117.8 | | |
| **Cond Strength, Sample 1** | | 145.1 | 116.0 | | | | 71.4 | 75.6 |
| **Uncond Strength, Sample 2** | | | | 133.0 | 111.4 | | | |
| **Cond Strength, Sample 2** | 127.2 | 133.7 | 113.2 | | | 125.7 | 76.4 | 65.0 |
| **Uncond Strength, Sample 3** | | 163.1 | 128.0 | 134.4 | | 109.8 | | 89.8 |
| **Cond Strength, Sample 3** | 138.5 | | | | 79.6 | | 73.5 | |
| **Uncond Strength, Sample 4** | 160.7 | | 130.2 | | 114.6 | | 81.3 | 84.8 |
| **Cond Strength, Sample 4** | | 140.2 | | 113.2 | | 82.8 | | |
| **Uncond Strength, Sample 5** | 172.9 | 182.6 | | | | 138.5 | 90.5 | |
| **Cond Strength, Sample 5** | | | 115.3 | 113.2 | 85.9 | | | 77.1 |
| **Uncond Strength, Sample 6** | | 169.6 | 131.6 | | | | 82.7 | 79.9 |
| **Cond Strength, Sample 6** | 135.3 | | | 114.6 | 89.1 | 74.8 | | |
| **Average Uncond Strength** | **166.4** | **171.8** | **129.9** | **130.9** | **112.5** | **122.0** | **84.8** | **84.8** |
| **Avg Uncond Str., Set A & B** | **169.1** | | **130.4** | | **117.3** | | **84.8** | |
| **Average Cond Strength** | **133.7** | **139.7** | **114.8** | **113.7** | **84.9** | **94.4** | **73.8** | **72.6** |
| **Avg Cond Str., Set A & B** | **136.7** | | **114.3** | | **89.7** | | **73.2** | |
| **Avg Uncond Str. w/Additive** | | | | | 112.5 | 122.0 | 84.8 | 84.8 |
| **Avg Cond Str. w/Additive** | | | | | 84.9 | 94.4 | 73.8 | 72.6 |
| **TSR** | **0.803** | **0.813** | **0.884** | **0.869** | **0.755** | **0.774** | **0.870** | **0.855** |
| **TSR, Set A & B** | **0.808** | | **0.876** | | **0.765** | | **0.862** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **025** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.355 | 2.361 | 2.361 | 2.356 | 2.334 | 2.336 | 2.345 | 2.340 |
| **Gmb, Standard Deviation** | 0.0046 | 0.0046 | 0.0026 | 0.0051 | 0.0079 | 0.0112 | 0.0041 | 0.0055 |
| **Gmb, Maximum** | 2.362 | 2.367 | 2.364 | 2.361 | 2.346 | 2.351 | 2.349 | 2.346 |
| **Gmb, Minimum** | 2.351 | 2.355 | 2.356 | 2.347 | 2.325 | 2.325 | 2.340 | 2.331 |
| **Gmb, Range** | 0.011 | 0.012 | 0.008 | 0.014 | 0.021 | 0.026 | 0.009 | 0.015 |
| **Gmb, Average, Set A & B** | 2.358 | | 2.358 | | 2.335 | | 2.343 | |
| **Gmb, STDEV, Set A & B** | 0.0056 | | 0.0047 | | 0.0093 | | 0.0053 | |
| **Gmb, Maximum, Set A & B** | 2.367 | | 2.364 | | 2.351 | | 2.349 | |
| **Gmb, Minimum, Set A & B** | 2.351 | | 2.347 | | 2.325 | | 2.331 | |
| **Gmb, Range Set, A & B** | 0.016 | | 0.017 | | 0.026 | | 0.018 | |
| **Voids, Average** | 7.2 | 6.9 | 6.9 | 7.2 | 7.2 | 7.1 | 6.7 | 6.9 |
| **Voids, Standard Deviation** | 0.18 | 0.16 | 0.10 | 0.22 | 0.31 | 0.45 | 0.15 | 0.23 |
| **Voids, Maximum** | 7.3 | 7.1 | 7.1 | 7.5 | 7.5 | 7.5 | 6.9 | 7.3 |
| **Voids, Minimum** | 6.9 | 6.7 | 6.8 | 6.9 | 6.7 | 6.5 | 6.6 | 6.7 |
| **Voids, Range** | 0.4 | 0.4 | 0.3 | 0.6 | 0.8 | 1.0 | 0.3 | 0.6 |
| **Voids, Average Set A & B** | 7.0 | | 7.0 | | 7.1 | | 6.8 | |
| **Voids, STDEV, Set A & B** | 0.22 | | 0.20 | | 0.37 | | 0.21 | |
| **Voids, Maximum, Set A & B** | 7.3 | | 7.5 | | 7.5 | | 7.3 | |
| **Voids, Minimun, Set & B** | 6.7 | | 6.8 | | 6.5 | | 6.6 | |
| **Voids, Range, Set A & B** | 0.6 | | 0.7 | | 1.0 | | 0.7 | |
| **% Saturation, Average** | 70.2 | 69.7 | 70.7 | 69.8 | 70.9 | 70.9 | 70.0 | 71.0 |
| **% Saturation, STDEV** | 1.0 | 0.9 | 0.7 | 0.7 | 0.3 | 1.2 | 0.8 | 0.3 |
| **% Saturation, Maximum** | 71.3 | 70.4 | 71.4 | 70.3 | 71.2 | 71.8 | 70.7 | 71.4 |
| **% Saturation, Minimum** | 69.3 | 68.7 | 70.0 | 69.0 | 70.7 | 69.5 | 69.2 | 70.8 |
| **% Saturation, Range** | 2.0 | 1.7 | 1.4 | 1.3 | 0.5 | 2.3 | 1.5 | 0.6 |
| **% Sat, Avg, Set A & B** | 70.0 | | 70.3 | | 70.9 | | 70.5 | |
| **% Sat, STDEV, Set A & B** | 0.9 | | 0.8 | | 0.8 | | 0.8 | |
| **% Sat, Maximum, Set A & B** | 71.3 | | 71.4 | | 71.8 | | 71.4 | |
| **% Sat, Minimum, Set A & B** | 68.7 | | 69.0 | | 69.5 | | 69.2 | |
| **% Sat, Range, Set A & B** | 2.6 | | 2.4 | | 2.3 | | 2.2 | |
| **Uncond Strength, Average** | 166.4 | 171.8 | 129.9 | 130.9 | 112.5 | 122.0 | 84.8 | 84.8 |
| **Uncond Strength, STDEV** | 6.1 | 9.9 | 1.8 | 5.0 | 1.8 | 14.8 | 5.0 | 5.0 |
| **Uncond Strength, MAX** | 172.9 | 182.6 | 131.6 | 134.4 | 114.6 | 138.5 | 90.5 | 89.8 |
| **Uncond Strength, MIN** | 160.7 | 163.1 | 128.0 | 125.2 | 111.4 | 109.8 | 81.3 | 79.9 |
| **Uncond Strength, Range** | 12.2 | 19.5 | 3.6 | 9.2 | 3.2 | 28.7 | 9.2 | 9.9 |
| **Uncond Str, Avg, Set A & B** | 169.1 | | 130.4 | | 117.3 | | 84.8 | |
| **Unc Str, STDEV, Set A & B** | 8.0 | | 3.4 | | 10.8 | | 4.4 | |
| **Uncnd Str, MAX, Set A & B** | 182.6 | | 134.4 | | 138.5 | | 90.5 | |
| **Uncnd Str, MIN, Set A & B** | 160.7 | | 125.2 | | 109.8 | | 79.9 | |
| **Unc Str, Range, Set A & B** | 21.9 | | 9.2 | | 28.7 | | 10.6 | |
| **Cond Strength, Average** | 133.7 | 139.7 | 114.8 | 113.7 | 84.9 | 94.4 | 73.8 | 72.6 |
| **Cond Strength, STDEV** | 5.8 | 5.7 | 1.5 | 0.8 | 4.8 | 27.4 | 2.5 | 6.6 |
| **Cond Strength, MAX** | 138.5 | 145.1 | 116.0 | 114.6 | 89.1 | 125.7 | 76.4 | 77.1 |
| **Cond Strength, MIN** | 127.2 | 133.7 | 113.2 | 113.2 | 79.6 | 74.8 | 71.4 | 65.0 |
| **Cond Strength, Range** | 11.3 | 11.4 | 2.8 | 1.4 | 9.5 | 50.9 | 5.0 | 12.1 |
| **Cond Str, Avg, Set A & B** | 136.7 | | 114.3 | | 89.7 | | 73.2 | |
| **Cond Str, STDEV, Set A & B** | 6.1 | | 1.2 | | 18.3 | | 4.5 | |
| **Cond Str, MAX, Set A & B** | 145.1 | | 116.0 | | 125.7 | | 77.1 | |
| **Cond Str, MIN, Set A & B** | 127.2 | | 113.2 | | 74.8 | | 65.0 | |
| **Cond Str, Range, Set A & B** | 17.9 | | 2.8 | | 50.9 | | 12.1 | |
| **TSR** | 0.803 | 0.813 | 0.884 | 0.869 | 0.755 | 0.774 | 0.870 | 0.855 |
| **TSR, Set A & B** | 0.808 | | 0.876 | | 0.765 | | 0.862 | |
| TSR DIFFERENCE, 6" - 4" | 0.068 | | | | 0.098 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **027** |
| **District Number** | District 5 |
| **Mix Design Number** | 85BIT1473 |
| **Material Code** | 19534 |
| **Type Mix** | Bit Conc SC N90 D (Type 2 D Surface) |
| **District Gmm** | 2.439 |
| **Producer** | Ashford |
| **P/S Number** | 5257-02 |
| **Location** | Marshall |
| **Contract Number** | 90761 |
| **Date Sampled** | 07/19/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N90 |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 031CMM16 |
| **Name of Coarse #1** | Crushed Gravel |
| **% of Coarse #1** | 56.0 |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 039FAM20 |
| **Name Fine #1** | Crushed Gravel Sand |
| **% Fine #1** | 20.5 |
| **Fine Aggregate #2** | 037FAM01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 19.4 |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 4.1 |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.5 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | Mix Design Verification @ 0.779 (Ashford - Marshall Mix Design @ 0.95) |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **027** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.297 | 2.293 | 2.280 | 2.282 | 2.290 | 2.286 | 2.280 | |
| **Gmb, Sample 2** | 2.289 | 2.289 | 2.286 | 2.292 | 2.285 | 2.282 | 2.276 | |
| **Gmb, Sample 3** | 2.296 | 2.290 | 2.283 | 2.290 | 2.292 | 2.277 | 2.278 | |
| **Gmb, Sample 4** | 2.297 | 2.301 | 2.291 | 2.288 | 2.280 | 2.281 | 2.285 | |
| **Gmb, Sample 5** | 2.295 | 2.289 | 2.288 | 2.284 | 2.279 | 2.290 | 2.282 | |
| **Gmb, Sample 6** | 2.283 | 2.295 | 2.293 | 2.283 | 2.275 | 2.283 | 2.284 | |
| **Gmb, Average** | **2.293** | **2.293** | **2.287** | **2.287** | **2.284** | **2.283** | **2.281** | |
| **Gmb, Average Set A & B** | **2.293** | | **2.287** | | **2.283** | | **2.281** | |
| **BMPR Gmm** | 2.464 | | 2.464 | | 2.451 | | 2.451 | |
| **Voids, Sample 1** | 6.8 | 6.9 | 7.5 | 7.4 | 6.6 | 6.7 | 7.0 | |
| **Voids, Sample 2** | 7.1 | 7.1 | 7.2 | 7.0 | 6.8 | 6.9 | 7.1 | |
| **Voids, Sample 3** | 6.8 | 7.1 | 7.4 | 7.1 | 6.5 | 7.1 | 7.1 | |
| **Voids, Sample 4** | 6.8 | 6.6 | 7.0 | 7.1 | 7.0 | 6.9 | 6.8 | |
| **Voids, Sample 5** | 6.9 | 7.1 | 7.1 | 7.3 | 7.0 | 6.6 | 6.9 | |
| **Voids, Sample 6** | 7.3 | 6.9 | 6.9 | 7.4 | 7.2 | 6.9 | 6.8 | |
| **Voids, Average** | **7.0** | **7.0** | **7.2** | **7.2** | **6.9** | **6.9** | **7.0** | |
| **Voids, Average Set A & B** | **7.0** | | **7.2** | | **6.9** | | **7.0** | |
| **% Saturated, Sample 1** | | | 70.3 | 71.3 | 70.3 | 69.0 | 70.7 | |
| **% Saturated, Sample 2** | 69.8 | 69.8 | 70.8 | 70.9 | 71.6 | 71.5 | 69.0 | |
| **% Saturated, Sample 3** | 69.3 | | | | | | | |
| **% Saturated, Sample 4** | | 68.4 | | | 71.0 | 71.4 | 70.8 | |
| **% Saturated, Sample 5** | 69.9 | 69.0 | | 69.5 | | | | |
| **% Saturated, Sample 6** | | | 68.2 | | | | | |
| **Average % Saturation** | **69.7** | **69.1** | **69.8** | **70.6** | **71.0** | **70.6** | **70.2** | |
| **Avg. % Sat. Set A & B** | **69.4** | | **70.2** | | **70.8** | | **70.2** | |
| **Cond or Uncond, Sample 1** | Uncond | Uncond | Cond | Cond | Cond | Cond | Cond | |
| **Cond or Uncond, Sample 2** | Cond | Cond | Cond | Cond | Cond | Cond | Cond | |
| **Cond or Uncond, Sample 3** | Cond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | |
| **Cond or Uncond, Sample 4** | Uncond | Cond | Uncond | Uncond | Cond | Cond | Cond | |
| **Cond or Uncond, Sample 5** | Cond | Cond | Uncond | Cond | Uncond | Uncond | Uncond | |
| **Cond or Uncond, Sample 6** | Uncond | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | |
| **Uncond Strength, Sample 1** | 176.7 | 168.7 | | | | | | |
| **Cond Strength, Sample 1** | | | 118.8 | 113.2 | 85.9 | 87.5 | 73.5 | |
| **Uncond Strength, Sample 2** | | | | | | | | |
| **Cond Strength, Sample 2** | 140.1 | 151.2 | 117.4 | 116.0 | 109.8 | 89.1 | 82.0 | |
| **Uncond Strength, Sample 3** | | 171.9 | 121.7 | 128.7 | 130.5 | 143.2 | 92.6 | |
| **Cond Strength, Sample 3** | 149.6 | | | | | | | |
| **Uncond Strength, Sample 4** | 183.0 | | 130.2 | 128.7 | | | | |
| **Cond Strength, Sample 4** | | 152.8 | | | 85.9 | 93.9 | 83.4 | |
| **Uncond Strength, Sample 5** | | | 131.6 | | 128.9 | 136.9 | 83.4 | |
| **Cond Strength, Sample 5** | 157.6 | 156.0 | | 117.4 | | | | |
| **Uncond Strength, Sample 6** | 168.7 | 171.9 | | 130.2 | 140.1 | 133.7 | 90.5 | |
| **Cond Strength, Sample 6** | | | 121.7 | | | | | |
| **Average Uncond Strength** | **176.1** | **170.8** | **127.8** | **129.2** | **133.2** | **137.9** | **88.8** | |
| **Avg Uncond Str., Set A & B** | **173.5** | | **128.5** | | **135.6** | | **88.8** | |
| **Average Cond Strength** | **149.1** | **153.3** | **119.3** | **115.5** | **93.9** | **90.2** | **79.6** | |
| **Avg Cond Str., Set A & B** | **151.2** | | **117.4** | | **92.0** | | **79.6** | |
| **Avg Uncond Str. w/Additive** | | | | | 133.2 | 137.9 | 88.8 | |
| **Avg Cond Str. w/Additive** | | | | | 93.9 | 90.2 | 79.6 | |
| **TSR** | **0.847** | **0.898** | **0.933** | **0.894** | **0.705** | **0.654** | **0.896** | |
| **TSR, Set A & B** | **0.872** | | **0.914** | | **0.679** | | **0.896** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **027** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.293 | 2.293 | 2.287 | 2.287 | 2.284 | 2.283 | 2.281 | |
| **Gmb, Standard Deviation** | 0.0057 | 0.0047 | 0.0049 | 0.0041 | 0.0067 | 0.0044 | 0.0035 | |
| **Gmb, Maximum** | 2.297 | 2.301 | 2.293 | 2.292 | 2.292 | 2.290 | 2.285 | |
| **Gmb, Minimum** | 2.283 | 2.289 | 2.280 | 2.282 | 2.275 | 2.277 | 2.276 | |
| **Gmb, Range** | 0.014 | 0.012 | 0.013 | 0.010 | 0.017 | 0.013 | 0.009 | |
| **Gmb, Average, Set A & B** | 2.293 | | 2.287 | | 2.283 | | 2.281 | |
| **Gmb, STDEV, Set A & B** | 0.0050 | | 0.0043 | | 0.0054 | | 0.0035 | |
| **Gmb, Maximum, Set A & B** | 2.301 | | 2.293 | | 2.292 | | 2.285 | |
| **Gmb, Minimum, Set A & B** | 2.283 | | 2.280 | | 2.275 | | 2.276 | |
| **Gmb, Range Set, A & B** | 0.018 | | 0.013 | | 0.017 | | 0.009 | |
| **Voids, Average** | 7.0 | 7.0 | 7.2 | 7.2 | 6.9 | 6.9 | 7.0 | |
| **Voids, Standard Deviation** | 0.21 | 0.20 | 0.23 | 0.17 | 0.27 | 0.18 | 0.14 | |
| **Voids, Maximum** | 7.3 | 7.1 | 7.5 | 7.4 | 7.2 | 7.1 | 7.1 | |
| **Voids, Minimum** | 6.8 | 6.6 | 6.9 | 7.0 | 6.5 | 6.6 | 6.8 | |
| **Voids, Range** | 0.5 | 0.5 | 0.6 | 0.4 | 0.7 | 0.5 | 0.3 | |
| **Voids, Average Set A & B** | 7.0 | | 7.2 | | 6.9 | | 7.0 | |
| **Voids, STDEV, Set A & B** | 0.19 | | 0.20 | | 0.22 | | 0.14 | |
| **Voids, Maximum, Set A & B** | 7.3 | | 7.5 | | 7.2 | | 7.1 | |
| **Voids, Minimun, Set & B** | 6.6 | | 6.9 | | 6.5 | | 6.8 | |
| **Voids, Range, Set A & B** | 0.7 | | 0.6 | | 0.7 | | 0.3 | |
| **% Saturation, Average** | 69.7 | 69.1 | 69.8 | 70.6 | 71.0 | 70.6 | 70.2 | |
| **% Saturation, STDEV** | 0.3 | 0.7 | 1.4 | 0.9 | 0.7 | 1.4 | 1.0 | |
| **% Saturation, Maximum** | 69.9 | 69.8 | 70.8 | 71.3 | 71.6 | 71.5 | 70.8 | |
| **% Saturation, Minimum** | 69.3 | 68.4 | 68.2 | 69.5 | 70.3 | 69.0 | 69.0 | |
| **% Saturation, Range** | 0.6 | 1.4 | 2.6 | 1.8 | 1.3 | 2.5 | 1.8 | |
| **% Sat, Avg, Set A & B** | 69.4 | | 70.2 | | 70.8 | | 70.2 | |
| **% Sat, STDEV, Set A & B** | 0.6 | | 1.1 | | 1.0 | | 1.0 | |
| **% Sat, Maximum, Set A & B** | 69.9 | | 71.3 | | 71.6 | | 70.8 | |
| **% Sat, Minimum, Set A & B** | 68.4 | | 68.2 | | 69.0 | | 69.0 | |
| **% Sat, Range, Set A & B** | 1.5 | | 3.1 | | 2.6 | | 1.8 | |
| **Uncond Strength, Average** | 176.1 | 170.8 | 127.8 | 129.2 | 133.2 | 137.9 | 88.8 | |
| **Uncond Strength, STDEV** | 7.2 | 1.8 | 5.4 | 0.9 | 6.1 | 4.8 | 4.8 | |
| **Uncond Strength, MAX** | 183.0 | 171.9 | 131.6 | 130.2 | 140.1 | 143.2 | 92.6 | |
| **Uncond Strength, MIN** | 168.7 | 168.7 | 121.7 | 128.7 | 128.9 | 133.7 | 83.4 | |
| **Uncond Strength, Range** | 14.3 | 3.2 | 9.9 | 1.5 | 11.2 | 9.5 | 9.2 | |
| **Uncond Str, Avg, Set A & B** | 173.5 | | 128.5 | | 135.6 | | 88.8 | |
| **Unc Str, STDEV, Set A & B** | 5.5 | | 3.5 | | 5.6 | | 4.8 | |
| **Uncnd Str, MAX, Set A & B** | 183.0 | | 131.6 | | 143.2 | | 92.6 | |
| **Uncnd Str, MIN, Set A & B** | 168.7 | | 121.7 | | 128.9 | | 83.4 | |
| **Unc Str, Range, Set A & B** | 14.3 | | 9.9 | | 14.3 | | 9.2 | |
| **Cond Strength, Average** | 149.1 | 153.3 | 119.3 | 115.5 | 93.9 | 90.2 | 79.6 | |
| **Cond Strength, STDEV** | 8.8 | 2.4 | 2.2 | 2.1 | 13.8 | 3.3 | 5.4 | |
| **Cond Strength, MAX** | 157.6 | 156.0 | 121.7 | 117.4 | 109.8 | 93.9 | 83.4 | |
| **Cond Strength, MIN** | 140.1 | 151.2 | 117.4 | 113.2 | 85.9 | 87.5 | 73.5 | |
| **Cond Strength, Range** | 17.5 | 4.8 | 4.3 | 4.2 | 23.9 | 6.4 | 9.9 | |
| **Cond Str, Avg, Set A & B** | 151.2 | | 117.4 | | 92.0 | | 79.6 | |
| **Cond Str, STDEV, Set A & B** | 6.2 | | 2.8 | | 9.2 | | 5.4 | |
| **Cond Str, MAX, Set A & B** | 157.6 | | 121.7 | | 109.8 | | 83.4 | |
| **Cond Str, MIN, Set A & B** | 140.1 | | 113.2 | | 85.9 | | 73.5 | |
| **Cond Str, Range, Set A & B** | 17.5 | | 8.5 | | 23.9 | | 9.9 | |
| **TSR** | 0.847 | 0.898 | 0.933 | 0.894 | 0.705 | 0.654 | 0.896 | |
| **TSR, Set A & B** | 0.872 | | 0.914 | | 0.679 | | 0.896 | |
| TSR DIFFERENCE, 6" - 4" | 0.042 | | | | 0.218 | | | |

# 4-inch -vs- 6-inch TSR Study

| | |
|---|---|
| **Date Data Entered** | |

| General Information | |
|---|---|
| **Lab Number** | **033A** |
| **District Number** | District 9 |
| **Mix Design Number** | 89BIT3772 |
| **Material Code** | 19544 |
| **Type Mix** | Type E, N105 |
| **District Gmm** | 2.452 |
| **Producer** | Southern Illinois Asphalt Company |
| **P/S Number** | 1813-09 |
| **Location** | Buncombe |
| **Contract Number** | |
| **Date Sampled** | Early June, 2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N 105 (37 Blow Marshall) |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 039CM13 |
| **Name of Coarse #1** | Sandstone |
| **% of Coarse #1** | 16.0 (produced @ 16.0) |
| **Coarse Aggregate #2** | 032CM16 |
| **Name of Coarse #2** | Crushed Limestone |
| **% of Coarse #2** | 43.1 (Produced @ 43.1) |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FA20 |
| **Name Fine #1** | Crushed Limestone Sand |
| **% Fine #1** | 29.7 (Produced @ 29.7) |
| **Fine Aggregate #2** | 037FA01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 10.2 (Produced @ 11.2) |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MF02 |
| **Name of MF** | Mineral Filler |
| **% of MF** | 1.0 (Produced @ 0.0) |
| **AC Grade** | PG 70-22 SBS Polymer |
| **% AC** | 5.34 (Produced @ 5.2) |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.81 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **033A** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.274 | 2.282 | 2.273 | 2.270 | 2.275 | 2.279 | 2.276 | 2.275 |
| **Gmb, Sample 2** | 2.279 | 2.285 | 2.276 | 2.271 | 2.277 | 2.269 | 2.272 | 2.277 |
| **Gmb, Sample 3** | 2.271 | 2.276 | 2.277 | 2.277 | 2.265 | 2.268 | 2.279 | 2.273 |
| **Gmb, Sample 4** | 2.276 | 2.288 | 2.274 | 2.271 | 2.277 | 2.276 | 2.275 | 2.275 |
| **Gmb, Sample 5** | 2.269 | 2.277 | 2.272 | 2.273 | 2.267 | 2.278 | 2.274 | 2.271 |
| **Gmb, Sample 6** | 2.268 | 2.278 | 2.274 | 2.271 | 2.268 | 2.265 | 2.278 | 2.277 |
| **Gmb, Average** | **2.273** | **2.281** | **2.274** | **2.272** | **2.272** | **2.273** | **2.276** | **2.275** |
| **Gmb, Average Set A & B** | **2.277** | | **2.273** | | **2.272** | | **2.275** | |
| **BMPR Gmm** | 2.451 | | 2.451 | | 2.447 | | 2.447 | |
| **Voids, Sample 1** | 7.2 | 6.9 | 7.3 | 7.4 | 7.0 | 6.9 | 7.0 | 7.0 |
| **Voids, Sample 2** | 7.0 | 6.8 | 7.1 | 7.3 | 6.9 | 7.3 | 7.2 | 6.9 |
| **Voids, Sample 3** | 7.3 | 7.1 | 7.1 | 7.1 | 7.4 | 7.3 | 6.9 | 7.1 |
| **Voids, Sample 4** | 7.1 | 6.7 | 7.2 | 7.3 | 6.9 | 7.0 | 7.0 | 7.0 |
| **Voids, Sample 5** | 7.4 | 7.1 | 7.3 | 7.3 | 7.4 | 6.9 | 7.1 | 7.2 |
| **Voids, Sample 6** | 7.5 | 7.1 | 7.2 | 7.3 | 7.3 | 7.4 | 6.9 | 6.9 |
| **Voids, Average** | **7.3** | **7.0** | **7.2** | **7.3** | **7.2** | **7.1** | **7.0** | **7.0** |
| **Voids, Average Set A & B** | **7.1** | | **7.2** | | **7.1** | | **7.0** | |
| **% Saturated, Sample 1** | | 70.5 | 70.0 | 68.3 | 70.7 | 68.9 | 71.9 | 70.2 |
| **% Saturated, Sample 2** | 68.4 | 68.0 | 70.5 | 71.6 | 71.2 | 69.6 | 71.4 | 71.1 |
| **% Saturated, Sample 3** | 69.6 | 71.5 | | 69.6 | 70.6 | 69.8 | 71.2 | 71.3 |
| **% Saturated, Sample 4** | | | 70.5 | | | | | |
| **% Saturated, Sample 5** | | | | | | | | |
| **% Saturated, Sample 6** | 69.9 | | | | | | | |
| **Average % Saturation** | **69.3** | **70.0** | **70.3** | **69.8** | **70.8** | **69.4** | **71.5** | **70.9** |
| **Avg. % Sat. Set A & B** | **69.7** | | **70.1** | | **70.1** | | **71.2** | |
| **Cond or Uncond, Sample 1** | Uncond | Cond | Cond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 2** | Cond | Cond | Cond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 3** | Cond | Cond | Uncond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 4** | Uncond | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | Cond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Uncond Strength, Sample 1** | 183.0 | | | | | | | |
| **Cond Strength, Sample 1** | | 138.5 | 131.6 | 138.6 | 43.0 | 43.0 | 46.7 | 40.2 |
| **Uncond Strength, Sample 2** | | | | | | | | |
| **Cond Strength, Sample 2** | 133.7 | 156.0 | 133.0 | 133.0 | 43.0 | 43.0 | 43.1 | 42.4 |
| **Uncond Strength, Sample 3** | | | 158.4 | | | | | |
| **Cond Strength, Sample 3** | 141.6 | 141.6 | | 135.8 | 39.8 | 43.0 | 44.5 | 42.4 |
| **Uncond Strength, Sample 4** | 191.0 | 198.9 | | 155.6 | 52.5 | 50.9 | 51.7 | 53.9 |
| **Cond Strength, Sample 4** | | | 131.6 | | | | | |
| **Uncond Strength, Sample 5** | 192.6 | 189.4 | 157.0 | 152.8 | 57.3 | 58.9 | 53.9 | 51.7 |
| **Cond Strength, Sample 5** | | | | | | | | |
| **Uncond Strength, Sample 6** | | 191.0 | 152.8 | 154.2 | 49.3 | 49.3 | 50.3 | 48.1 |
| **Cond Strength, Sample 6** | 135.3 | | | | | | | |
| **Average Uncond Strength** | **188.9** | **193.1** | **156.1** | **154.2** | **53.0** | **53.0** | **52.0** | **51.2** |
| **Avg Uncond Str., Set A & B** | **191.0** | | **155.1** | | **53.0** | | **51.6** | |
| **Average Cond Strength** | **136.9** | **145.4** | **132.1** | **135.8** | **41.9** | **43.0** | **44.8** | **41.7** |
| **Avg Cond Str., Set A & B** | **141.1** | | **133.9** | | **42.5** | | **43.2** | |
| **Avg Uncond Str. w/Additive** | | | | | 53.0 | 53.0 | 52.0 | 51.2 |
| **Avg Cond Str. w/Additive** | | | | | 41.9 | 43.0 | 44.8 | 41.7 |
| **TSR** | **0.725** | **0.753** | **0.846** | **0.881** | **0.791** | **0.811** | **0.861** | **0.813** |
| **TSR, Set A & B** | **0.739** | | **0.863** | | **0.801** | | **0.838** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **033A** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.273 | 2.281 | 2.274 | 2.272 | 2.272 | 2.273 | 2.276 | 2.275 |
| **Gmb, Standard Deviation** | 0.0043 | 0.0048 | 0.0019 | 0.0026 | 0.0054 | 0.0059 | 0.0026 | 0.0023 |
| **Gmb, Maximum** | 2.279 | 2.288 | 2.277 | 2.277 | 2.277 | 2.279 | 2.279 | 2.277 |
| **Gmb, Minimum** | 2.268 | 2.276 | 2.272 | 2.270 | 2.265 | 2.265 | 2.272 | 2.271 |
| **Gmb, Range** | 0.011 | 0.012 | 0.005 | 0.007 | 0.012 | 0.014 | 0.007 | 0.006 |
| **Gmb, Average, Set A & B** | 2.277 | | 2.273 | | 2.272 | | 2.275 | |
| **Gmb, STDEV, Set A & B** | 0.0061 | | 0.0024 | | 0.0054 | | 0.0024 | |
| **Gmb, Maximum, Set A & B** | 2.288 | | 2.277 | | 2.279 | | 2.279 | |
| **Gmb, Minimum, Set A & B** | 2.268 | | 2.270 | | 2.265 | | 2.271 | |
| **Gmb, Range Set, A & B** | 0.020 | | 0.007 | | 0.014 | | 0.008 | |
| **Voids, Average** | 7.3 | 7.0 | 7.2 | 7.3 | 7.2 | 7.1 | 7.0 | 7.0 |
| **Voids, Standard Deviation** | 0.19 | 0.18 | 0.09 | 0.10 | 0.24 | 0.23 | 0.12 | 0.12 |
| **Voids, Maximum** | 7.5 | 7.1 | 7.3 | 7.4 | 7.4 | 7.4 | 7.2 | 7.2 |
| **Voids, Minimum** | 7.0 | 6.7 | 7.1 | 7.1 | 6.9 | 6.9 | 6.9 | 6.9 |
| **Voids, Range** | 0.5 | 0.4 | 0.2 | 0.3 | 0.5 | 0.5 | 0.3 | 0.3 |
| **Voids, Average Set A & B** | 7.1 | | 7.2 | | 7.1 | | 7.0 | |
| **Voids, STDEV, Set A & B** | 0.23 | | 0.10 | | 0.22 | | 0.11 | |
| **Voids, Maximum, Set A & B** | 7.5 | | 7.4 | | 7.4 | | 7.2 | |
| **Voids, Minimun, Set & B** | 6.7 | | 7.1 | | 6.9 | | 6.9 | |
| **Voids, Range, Set A & B** | 0.8 | | 0.3 | | 0.5 | | 0.3 | |
| **% Saturation, Average** | 69.3 | 70.0 | 70.3 | 69.8 | 70.8 | 69.4 | 71.5 | 70.9 |
| **% Saturation, STDEV** | 0.8 | 1.8 | 0.3 | 1.7 | 0.3 | 0.5 | 0.4 | 0.6 |
| **% Saturation, Maximum** | 69.9 | 71.5 | 70.5 | 71.6 | 71.2 | 69.8 | 71.9 | 71.3 |
| **% Saturation, Minimum** | 68.4 | 68.0 | 70.0 | 68.3 | 70.6 | 68.9 | 71.2 | 70.2 |
| **% Saturation, Range** | 1.5 | 3.5 | 0.5 | 3.3 | 0.6 | 0.9 | 0.7 | 1.1 |
| **% Sat, Avg, Set A & B** | 69.7 | | 70.1 | | 70.1 | | 71.2 | |
| **% Sat, STDEV, Set A & B** | 1.3 | | 1.1 | | 0.8 | | 0.6 | |
| **% Sat, Maximum, Set A & B** | 71.5 | | 71.6 | | 71.2 | | 71.9 | |
| **% Sat, Minimum, Set A & B** | 68.0 | | 68.3 | | 68.9 | | 70.2 | |
| **% Sat, Range, Set A & B** | 3.5 | | 3.3 | | 2.3 | | 1.7 | |
| **Uncond Strength, Average** | 188.9 | 193.1 | 156.1 | 154.2 | 53.0 | 53.0 | 52.0 | 51.2 |
| **Uncond Strength, STDEV** | 5.1 | 5.1 | 2.9 | 1.4 | 4.0 | 5.1 | 1.8 | 2.9 |
| **Uncond Strength, MAX** | 192.6 | 198.9 | 158.4 | 155.6 | 57.3 | 58.9 | 53.9 | 53.9 |
| **Uncond Strength, MIN** | 183.0 | 189.4 | 152.8 | 152.8 | 49.3 | 49.3 | 50.3 | 48.1 |
| **Uncond Strength, Range** | 9.6 | 9.5 | 5.6 | 2.8 | 8.0 | 9.6 | 3.6 | 5.8 |
| **Uncond Str, Avg, Set A & B** | 191.0 | | 155.1 | | 53.0 | | 51.6 | |
| **Unc Str, STDEV, Set A & B** | 5.1 | | 2.3 | | 4.1 | | 2.2 | |
| **Uncnd Str, MAX, Set A & B** | 198.9 | | 158.4 | | 58.9 | | 53.9 | |
| **Uncnd Str, MIN, Set A & B** | 183.0 | | 152.8 | | 49.3 | | 48.1 | |
| **Unc Str, Range, Set A & B** | 15.9 | | 5.6 | | 9.6 | | 5.8 | |
| **Cond Strength, Average** | 136.9 | 145.4 | 132.1 | 135.8 | 41.9 | 43.0 | 44.8 | 41.7 |
| **Cond Strength, STDEV** | 4.2 | 9.3 | 0.8 | 2.8 | 1.8 | 0.0 | 1.8 | 1.3 |
| **Cond Strength, MAX** | 141.6 | 156.0 | 133.0 | 138.6 | 43.0 | 43.0 | 46.7 | 42.4 |
| **Cond Strength, MIN** | 133.7 | 138.5 | 131.6 | 133.0 | 39.8 | 43.0 | 43.1 | 40.2 |
| **Cond Strength, Range** | 7.9 | 17.5 | 1.4 | 5.6 | 3.2 | 0.0 | 3.6 | 2.2 |
| **Cond Str, Avg, Set A & B** | 141.1 | | 133.9 | | 42.5 | | 43.2 | |
| **Cond Str, STDEV, Set A & B** | 8.0 | | 2.8 | | 1.3 | | 2.2 | |
| **Cond Str, MAX, Set A & B** | 156.0 | | 138.6 | | 43.0 | | 46.7 | |
| **Cond Str, MIN, Set A & B** | 133.7 | | 131.6 | | 39.8 | | 40.2 | |
| **Cond Str, Range, Set A & B** | 22.3 | | 7.0 | | 3.2 | | 6.5 | |
| **TSR** | 0.725 | 0.753 | 0.846 | 0.881 | 0.791 | 0.811 | 0.861 | 0.813 |
| **TSR, Set A & B** | 0.739 | | 0.863 | | 0.801 | | 0.838 | |
| TSR DIFFERENCE, 6" - 4" | 0.124 | | | | 0.037 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **033B** |
| **District Number** | District 9 |
| **Mix Design Number** | 89BIT3768 |
| **Material Code** | 17555 |
| **Type Mix** | Type 1 E |
| **District Gmm** | 2.449 |
| **Producer** | Southern Illinois Asphalt Company |
| **P/S Number** | 1813-12 |
| **Location** | Buncombe |
| **Contract Number** | |
| **Date Sampled** | Late June, Early July, 2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N105 (45 Blow Marshall) |
| **Nominal Maximum Size** | 12.5 mm |
| **Coarse Aggregate #1** | 039CM13 |
| **Name of Coarse #1** | Sandstone |
| **% of Coarse #1** | 65.8 (Produced @ 65.8) |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FA20 |
| **Name Fine #1** | Crushed Limestone Sand |
| **% Fine #1** | 27.3 (Produced @ 26.2) |
| **Fine Aggregate #2** | 037FA01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 6.9 (Produced @ 8.0) |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | |
| **Name of MF** | |
| **% of MF** | |
| **AC Grade** | PG 70-22 SBS Polymer |
| **% AC** | 5.2 (Produced @ 5.0) |
| **Additive** | AD-HERE LOF 65-00LS |
| **% Additive** | 0.5% by weight of Asphalt ??) |
| **Design TSR** | 0.77 without additive (0.86 with additive - in Mix) |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **033B** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.279 | 2.270 | 2.275 | 2.270 | 2.272 | 2.276 | 2.274 | 2.273 |
| **Gmb, Sample 2** | 2.264 | 2.270 | 2.276 | 2.272 | 2.267 | 2.268 | 2.282 | 2.259 |
| **Gmb, Sample 3** | 2.279 | 2.271 | 2.277 | 2.274 | 2.279 | 2.283 | 2.268 | 2.287 |
| **Gmb, Sample 4** | 2.274 | 2.273 | 2.273 | 2.277 | 2.269 | 2.265 | 2.293 | 2.276 |
| **Gmb, Sample 5** | 2.290 | 2.284 | 2.276 | 2.272 | 2.284 | 2.272 | 2.267 | 2.267 |
| **Gmb, Sample 6** | 2.270 | 2.273 | 2.270 | 2.272 | 2.275 | 2.279 | 2.259 | 2.278 |
| **Gmb, Average** | **2.276** | **2.274** | **2.275** | **2.273** | **2.274** | **2.274** | **2.274** | **2.273** |
| **Gmb, Average Set A & B** | **2.275** | | **2.274** | | **2.274** | | **2.274** | |
| **BMPR Gmm** | 2.448 | | 2.448 | | 2.442 | | 2.442 | |
| **Voids, Sample 1** | 6.9 | 7.3 | 7.1 | 7.3 | 7.0 | 6.8 | 6.9 | 6.9 |
| **Voids, Sample 2** | 7.5 | 7.3 | 7.0 | 7.2 | 7.2 | 7.1 | 6.6 | 7.5 |
| **Voids, Sample 3** | 6.9 | 7.2 | 7.0 | 7.1 | 6.7 | 6.5 | 7.1 | 6.3 |
| **Voids, Sample 4** | 7.1 | 7.1 | 7.1 | 7.0 | 7.1 | 7.2 | 6.1 | 6.8 |
| **Voids, Sample 5** | 6.5 | 6.7 | 7.0 | 7.2 | 6.5 | 7.0 | 7.2 | 7.2 |
| **Voids, Sample 6** | 7.3 | 7.1 | 7.3 | 7.2 | 6.8 | 6.7 | 7.5 | 6.7 |
| **Voids, Average** | **7.0** | **7.1** | **7.1** | **7.2** | **6.9** | **6.9** | **6.9** | **6.9** |
| **Voids, Average Set A & B** | **7.1** | | **7.1** | | **6.9** | | **6.9** | |
| **% Saturated, Sample 1** | 71.1 | | 71.5 | 69.5 | 71.7 | 71.9 | 70.7 | 71.3 |
| **% Saturated, Sample 2** | | | 70.1 | 71.6 | 69.8 | 70.8 | 70.2 | 70.4 |
| **% Saturated, Sample 3** | 70.5 | 70.2 | | | 71.8 | 70.9 | 70.7 | 70.7 |
| **% Saturated, Sample 4** | 70.6 | 70.7 | 70.7 | 70.9 | | | | |
| **% Saturated, Sample 5** | | | | | | | | |
| **% Saturated, Sample 6** | | 69.6 | | | | | | |
| **Average % Saturation** | **70.7** | **70.2** | **70.8** | **70.7** | **71.1** | **71.2** | **70.5** | **70.8** |
| **Avg. % Sat. Set A & B** | **70.5** | | **70.7** | | **71.2** | | **70.7** | |
| **Cond or Uncond, Sample 1** | Cond | Uncond | Cond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 2** | Uncond | Uncond | Cond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 3** | Cond | Cond | Uncond | Uncond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 4** | Cond | Cond | Cond | Cond | Uncond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Uncond Strength, Sample 1** | | 187.8 | | | | | | |
| **Cond Strength, Sample 1** | 124.1 | | 124.5 | 127.3 | 34.2 | 39.8 | 45.3 | 38.1 |
| **Uncond Strength, Sample 2** | 191.0 | 191.0 | | | | | | |
| **Cond Strength, Sample 2** | | | 128.7 | 124.5 | 36.6 | 39.8 | 43.1 | 40.3 |
| **Uncond Strength, Sample 3** | | | 169.8 | 172.6 | | | | |
| **Cond Strength, Sample 3** | 117.8 | 111.4 | | | 38.2 | 39.8 | 38.1 | 42.4 |
| **Uncond Strength, Sample 4** | | | | | 57.3 | 52.8 | 53.9 | 48.2 |
| **Cond Strength, Sample 4** | 127.3 | 121.0 | 125.9 | 123.1 | | | | |
| **Uncond Strength, Sample 5** | 210.1 | 211.7 | 164.1 | 164.1 | 55.7 | 52.8 | 50.3 | 50.3 |
| **Cond Strength, Sample 5** | | | | | | | | |
| **Uncond Strength, Sample 6** | 191.0 | | 164.1 | 158.4 | 57.3 | 51.3 | 49.6 | 48.2 |
| **Cond Strength, Sample 6** | | 122.5 | | | | | | |
| **Average Uncond Strength** | **197.4** | **196.8** | **166.0** | **165.0** | **56.8** | **52.3** | **51.3** | **48.9** |
| **Avg Uncond Str., Set A & B** | **197.1** | | **165.5** | | **54.5** | | **50.1** | |
| **Average Cond Strength** | **123.1** | **118.3** | **126.4** | **125.0** | **36.3** | **39.8** | **42.2** | **40.3** |
| **Avg Cond Str., Set A & B** | **120.7** | | **125.7** | | **38.1** | | **41.2** | |
| **Avg Uncond Str. w/Additive** | | | | | 56.8 | 52.3 | 51.3 | 48.9 |
| **Avg Cond Str. w/Additive** | | | | | 36.3 | 39.8 | 42.2 | 40.3 |
| **TSR** | **0.624** | **0.601** | **0.761** | **0.757** | **0.640** | **0.761** | **0.822** | **0.823** |
| **TSR, Set A & B** | **0.612** | | **0.759** | | **0.698** | | **0.823** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **033B** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.276 | 2.274 | 2.275 | 2.273 | 2.274 | 2.274 | 2.274 | 2.273 |
| **Gmb, Standard Deviation** | 0.0089 | 0.0053 | 0.0026 | 0.0024 | 0.0064 | 0.0068 | 0.0121 | 0.0096 |
| **Gmb, Maximum** | 2.290 | 2.284 | 2.277 | 2.277 | 2.284 | 2.283 | 2.293 | 2.287 |
| **Gmb, Minimum** | 2.264 | 2.270 | 2.270 | 2.270 | 2.267 | 2.265 | 2.259 | 2.259 |
| **Gmb, Range** | 0.026 | 0.014 | 0.007 | 0.007 | 0.017 | 0.018 | 0.034 | 0.028 |
| **Gmb, Average, Set A & B** | 2.275 | | 2.274 | | 2.274 | | 2.274 | |
| **Gmb, STDEV, Set A & B** | 0.0071 | | 0.0025 | | 0.0063 | | 0.0104 | |
| **Gmb, Maximum, Set A & B** | 2.290 | | 2.277 | | 2.284 | | 2.293 | |
| **Gmb, Minimum, Set A & B** | 2.264 | | 2.270 | | 2.265 | | 2.259 | |
| **Gmb, Range Set, A & B** | 0.026 | | 0.007 | | 0.019 | | 0.034 | |
| **Voids, Average** | 7.0 | 7.1 | 7.1 | 7.2 | 6.9 | 6.9 | 6.9 | 6.9 |
| **Voids, Standard Deviation** | 0.35 | 0.22 | 0.12 | 0.10 | 0.26 | 0.26 | 0.49 | 0.41 |
| **Voids, Maximum** | 7.5 | 7.3 | 7.3 | 7.3 | 7.2 | 7.2 | 7.5 | 7.5 |
| **Voids, Minimum** | 6.5 | 6.7 | 7.0 | 7.0 | 6.5 | 6.5 | 6.1 | 6.3 |
| **Voids, Range** | 1.0 | 0.6 | 0.3 | 0.3 | 0.7 | 0.7 | 1.4 | 1.2 |
| **Voids, Average Set A & B** | 7.1 | | 7.1 | | 6.9 | | 6.9 | |
| **Voids, STDEV, Set A & B** | 0.28 | | 0.11 | | 0.25 | | 0.43 | |
| **Voids, Maximum, Set A & B** | 7.5 | | 7.3 | | 7.2 | | 7.5 | |
| **Voids, Minimun, Set & B** | 6.5 | | 7.0 | | 6.5 | | 6.1 | |
| **Voids, Range, Set A & B** | 1.0 | | 0.3 | | 0.7 | | 1.4 | |
| **% Saturation, Average** | 70.7 | 70.2 | 70.8 | 70.7 | 71.1 | 71.2 | 70.5 | 70.8 |
| **% Saturation, STDEV** | 0.3 | 0.6 | 0.7 | 1.1 | 1.1 | 0.6 | 0.3 | 0.5 |
| **% Saturation, Maximum** | 71.1 | 70.7 | 71.5 | 71.6 | 71.8 | 71.9 | 70.7 | 71.3 |
| **% Saturation, Minimum** | 70.5 | 69.6 | 70.1 | 69.5 | 69.8 | 70.8 | 70.2 | 70.4 |
| **% Saturation, Range** | 0.6 | 1.1 | 1.4 | 2.1 | 2.0 | 1.1 | 0.5 | 0.9 |
| **% Sat, Avg, Set A & B** | 70.5 | | 70.7 | | 71.2 | | 70.7 | |
| **% Sat, STDEV, Set A & B** | 0.5 | | 0.8 | | 0.8 | | 0.4 | |
| **% Sat, Maximum, Set A & B** | 71.1 | | 71.6 | | 71.9 | | 71.3 | |
| **% Sat, Minimum, Set A & B** | 69.6 | | 69.5 | | 69.8 | | 70.2 | |
| **% Sat, Range, Set A & B** | 1.5 | | 2.1 | | 2.1 | | 1.1 | |
| **Uncond Strength, Average** | 197.4 | 196.8 | 166.0 | 165.0 | 56.8 | 52.3 | 51.3 | 48.9 |
| **Uncond Strength, STDEV** | 11.0 | 13.0 | 3.3 | 7.1 | 0.9 | 0.9 | 2.3 | 1.2 |
| **Uncond Strength, MAX** | 210.1 | 211.7 | 169.8 | 172.6 | 57.3 | 52.8 | 53.9 | 50.3 |
| **Uncond Strength, MIN** | 191.0 | 187.8 | 164.1 | 158.4 | 55.7 | 51.3 | 49.6 | 48.2 |
| **Uncond Strength, Range** | 19.1 | 23.9 | 5.7 | 14.2 | 1.6 | 1.5 | 4.3 | 2.1 |
| **Uncond Str, Avg, Set A & B** | 197.1 | | 165.5 | | 54.5 | | 50.1 | |
| **Unc Str, STDEV, Set A & B** | 10.8 | | 5.0 | | 2.6 | | 2.1 | |
| **Uncnd Str, MAX, Set A & B** | 211.7 | | 172.6 | | 57.3 | | 53.9 | |
| **Uncnd Str, MIN, Set A & B** | 187.8 | | 158.4 | | 51.3 | | 48.2 | |
| **Unc Str, Range, Set A & B** | 23.9 | | 14.2 | | 6.0 | | 5.7 | |
| **Cond Strength, Average** | 123.1 | 118.3 | 126.4 | 125.0 | 36.3 | 39.8 | 42.2 | 40.3 |
| **Cond Strength, STDEV** | 4.8 | 6.0 | 2.1 | 2.1 | 2.0 | 0.0 | 3.7 | 2.2 |
| **Cond Strength, MAX** | 127.3 | 122.5 | 128.7 | 127.3 | 38.2 | 39.8 | 45.3 | 42.4 |
| **Cond Strength, MIN** | 117.8 | 111.4 | 124.5 | 123.1 | 34.2 | 39.8 | 38.1 | 38.1 |
| **Cond Strength, Range** | 9.5 | 11.1 | 4.2 | 4.2 | 4.0 | 0.0 | 7.2 | 4.3 |
| **Cond Str, Avg, Set A & B** | 120.7 | | 125.7 | | 38.1 | | 41.2 | |
| **Cond Str, STDEV, Set A & B** | 5.5 | | 2.1 | | 2.3 | | 2.9 | |
| **Cond Str, MAX, Set A & B** | 127.3 | | 128.7 | | 39.8 | | 45.3 | |
| **Cond Str, MIN, Set A & B** | 111.4 | | 123.1 | | 34.2 | | 38.1 | |
| **Cond Str, Range, Set A & B** | 15.9 | | 5.6 | | 5.6 | | 7.2 | |
| **TSR** | 0.624 | 0.601 | 0.761 | 0.757 | 0.640 | 0.761 | 0.822 | 0.823 |
| **TSR, Set A & B** | 0.612 | | 0.759 | | 0.698 | | 0.823 | |
| TSR DIFFERENCE, 6" - 4" | 0.147 | | | | 0.125 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **038** |
| **District Number** | District 6 |
| **Mix Design Number** | 86BIT3069 |
| **Material Code** | 19513M |
| **Type Mix** | Bit Conc Surface Course Type 2 C, N50 |
| **District Gmm** | 2.447 |
| **Producer** | Illinois Valley Paving Company |
| **P/S Number** | 943-26 |
| **Location** | Winchester |
| **Contract Number** | |
| **Date Sampled** | 08/09/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N50 |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 032CMM16 |
| **Name of Coarse #1** | Crushed Limestone |
| **% of Coarse #1** | 68.3 (Produced @ 71.0 %) |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FMM21 |
| **Name Fine #1** | Crushed Limestone Sand |
| **% Fine #1** | 18.0 (Produced @ 15.0 %) |
| **Fine Aggregate #2** | 037FAM01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 12.8 (produced @ 14.0 %) |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 0.9 in design, (Produced @ 0.0 %) |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.0 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.81 |

**NOTE: The 6" samples for the 038 mix were designed and compacted to 4 1/2 " high instead of 3 3/4 " high**

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **038** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch @ 4.5" high** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.295 | 2.317 | 2.295 | 2.298 | 2.284 | 2.278 | 2.272 | 2.287 |
| **Gmb, Sample 2** | 2.305 | 2.308 | 2.305 | 2.301 | 2.290 | 2.264 | 2.286 | 2.280 |
| **Gmb, Sample 3** | 2.310 | 2.309 | 2.290 | 2.296 | 2.273 | 2.286 | 2.290 | 2.287 |
| **Gmb, Sample 4** | 2.311 | 2.298 | 2.292 | 2.299 | 2.282 | 2.282 | 2.293 | 2.295 |
| **Gmb, Sample 5** | 2.309 | 2.302 | 2.297 | 2.302 | 2.286 | 2.279 | 2.284 | 2.284 |
| **Gmb, Sample 6** | 2.312 | 2.305 | 2.293 | 2.295 | 2.261 | 2.282 | 2.281 | 2.284 |
| **Gmb, Average** | **2.307** | **2.307** | **2.295** | **2.299** | **2.279** | **2.279** | **2.284** | **2.286** |
| **Gmb, Average Set A & B** | **2.307** | | **2.297** | | **2.279** | | **2.285** | |
| **BMPR Gmm** | 2.477 | | 2.477 | | 2.451 | | 2.455 | |
| **Voids, Sample 1** | 7.3 | 6.5 | 7.3 | 7.2 | 6.8 | 7.1 | 7.5 | 6.8 |
| **Voids, Sample 2** | 6.9 | 6.8 | 6.9 | 7.1 | 6.6 | 7.6 | 6.9 | 7.1 |
| **Voids, Sample 3** | 6.7 | 6.8 | 7.5 | 7.3 | 7.3 | 6.7 | 6.7 | 6.8 |
| **Voids, Sample 4** | 6.7 | 7.2 | 7.5 | 7.2 | 6.9 | 6.9 | 6.6 | 6.5 |
| **Voids, Sample 5** | 6.8 | 7.1 | 7.3 | 7.1 | 6.7 | 7.0 | 7.0 | 7.0 |
| **Voids, Sample 6** | 6.7 | 6.9 | 7.4 | 7.3 | 7.8 | 6.9 | 7.1 | 7.0 |
| **Voids, Average** | **6.9** | **6.9** | **7.3** | **7.2** | **7.0** | **7.0** | **7.0** | **6.9** |
| **Voids, Average Set A & B** | **6.9** | | **7.3** | | **7.0** | | **6.9** | |
| **% Saturated, Sample 1** | 70.6 | 68.0 | | | 69.3 | 70.7 | | 69.6 |
| **% Saturated, Sample 2** | | | 70.2 | | | | 71.8 | |
| **% Saturated, Sample 3** | | | 70.2 | | 71.7 | | | 71.6 |
| **% Saturated, Sample 4** | 69.0 | 70.1 | | 71.2 | 71.2 | 70.1 | | 71.4 |
| **% Saturated, Sample 5** | | | | 71.0 | | 70.9 | 70.5 | |
| **% Saturated, Sample 6** | 69.6 | 68.8 | 71.6 | 69.5 | | | 69.3 | |
| **Average % Saturation** | **69.7** | **69.0** | **70.7** | **70.6** | **70.7** | **70.6** | **70.5** | **70.9** |
| **Avg. % Sat. Set A & B** | **69.4** | | **70.6** | | **70.7** | | **70.7** | |
| **Cond or Uncond, Sample 1** | Cond | Cond | Uncond | Uncond | Cond | Cond | Uncond | Cond |
| **Cond or Uncond, Sample 2** | Uncond | Uncond | Cond | Uncond | Uncond | Uncond | Cond | Uncond |
| **Cond or Uncond, Sample 3** | Uncond | Uncond | Cond | Uncond | Cond | Uncond | Uncond | Cond |
| **Cond or Uncond, Sample 4** | Cond | Cond | Uncond | Cond | Cond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Uncond | Uncond | Uncond | Cond | Uncond | Cond | Cond | Uncond |
| **Cond or Uncond, Sample 6** | Cond | Cond | Cond | Cond | Uncond | Uncond | Cond | Cond |
| **Uncond Strength, Sample 1** | | | 121.7 | 123.1 | | | 73.7 | |
| **Cond Strength, Sample 1** | 92.3 | 104.5 | | | 76.1 | 96.3 | | 60.7 |
| **Uncond Strength, Sample 2** | 170.3 | 156.6 | | 127.3 | 87.5 | 130.4 | | 89.0 |
| **Cond Strength, Sample 2** | | | 90.5 | | | | 60.1 | |
| **Uncond Strength, Sample 3** | 182.8 | 165.5 | | 121.7 | | 122.5 | 83.7 | |
| **Cond Strength, Sample 3** | | | 84.9 | | 94.7 | | | 70.1 |
| **Uncond Strength, Sample 4** | | | 123.1 | | | | 87.2 | 87.2 |
| **Cond Strength, Sample 4** | 97.8 | 92.3 | | 82.1 | 76.4 | 74.8 | | |
| **Uncond Strength, Sample 5** | 168.7 | 160.8 | 123.1 | | 122.5 | | | 81.9 |
| **Cond Strength, Sample 5** | | | | 87.7 | | 82.3 | 61.3 | |
| **Uncond Strength, Sample 6** | | | | | 104.0 | 119.4 | | |
| **Cond Strength, Sample 6** | 102.7 | 93.9 | 87.7 | 92.0 | | | 67.2 | 61.9 |
| **Average Uncond Strength** | **173.9** | **160.9** | **122.6** | **124.0** | **104.7** | **124.1** | **81.5** | **86.0** |
| **Avg Uncond Str., Set A & B** | **167.4** | | **123.3** | | **114.4** | | **83.8** | |
| **Average Cond Strength** | **97.6** | **96.9** | **87.7** | **87.3** | **82.4** | **84.5** | **62.9** | **64.2** |
| **Avg Cond Str., Set A & B** | **97.2** | | **87.5** | | **83.4** | | **63.6** | |
| **Avg Uncond Str. w/Additive** | | | | | 104.7 | 124.1 | 81.5 | 86.0 |
| **Avg Cond Str. w/Additive** | | | | | 82.4 | 84.5 | 62.9 | 64.2 |
| **TSR** | **0.561** | **0.602** | **0.715** | **0.704** | **0.787** | **0.681** | **0.771** | **0.747** |
| **TSR, Set A & B** | **0.581** | | **0.709** | | **0.729** | | **0.759** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **038** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.307 | 2.307 | 2.295 | 2.299 | 2.279 | 2.279 | 2.284 | 2.286 |
| **Gmb, Standard Deviation** | 0.0064 | 0.0065 | 0.0053 | 0.0027 | 0.0106 | 0.0076 | 0.0074 | 0.0050 |
| **Gmb, Maximum** | 2.312 | 2.317 | 2.305 | 2.302 | 2.290 | 2.286 | 2.293 | 2.295 |
| **Gmb, Minimum** | 2.295 | 2.298 | 2.290 | 2.295 | 2.261 | 2.264 | 2.272 | 2.280 |
| **Gmb, Range** | 0.017 | 0.019 | 0.015 | 0.007 | 0.029 | 0.022 | 0.021 | 0.015 |
| **Gmb, Average, Set A & B** | 2.307 | | 2.297 | | 2.279 | | 2.285 | |
| **Gmb, STDEV, Set A & B** | 0.0062 | | 0.0044 | | 0.0088 | | 0.0061 | |
| **Gmb, Maximum, Set A & B** | 2.317 | | 2.305 | | 2.290 | | 2.295 | |
| **Gmb, Minimum, Set A & B** | 2.295 | | 2.290 | | 2.261 | | 2.272 | |
| **Gmb, Range Set, A & B** | 0.022 | | 0.015 | | 0.029 | | 0.023 | |
| **Voids, Average** | 6.9 | 6.9 | 7.3 | 7.2 | 7.0 | 7.0 | 7.0 | 6.9 |
| **Voids, Standard Deviation** | 0.23 | 0.25 | 0.22 | 0.09 | 0.45 | 0.31 | 0.32 | 0.22 |
| **Voids, Maximum** | 7.3 | 7.2 | 7.5 | 7.3 | 7.8 | 7.6 | 7.5 | 7.1 |
| **Voids, Minimum** | 6.7 | 6.5 | 6.9 | 7.1 | 6.6 | 6.7 | 6.6 | 6.5 |
| **Voids, Range** | 0.6 | 0.7 | 0.6 | 0.2 | 1.2 | 0.9 | 0.9 | 0.6 |
| **Voids, Average Set A & B** | 6.9 | | 7.3 | | 7.0 | | 6.9 | |
| **Voids, STDEV, Set A & B** | 0.23 | | 0.17 | | 0.37 | | 0.27 | |
| **Voids, Maximum, Set A & B** | 7.3 | | 7.5 | | 7.8 | | 7.5 | |
| **Voids, Minimun, Set & B** | 6.5 | | 6.9 | | 6.6 | | 6.5 | |
| **Voids, Range, Set A & B** | 0.8 | | 0.6 | | 1.2 | | 1.0 | |
| **% Saturation, Average** | 69.7 | 69.0 | 70.7 | 70.6 | 70.7 | 70.6 | 70.5 | 70.9 |
| **% Saturation, STDEV** | 0.8 | 1.1 | 0.8 | 0.9 | 1.3 | 0.4 | 1.3 | 1.1 |
| **% Saturation, Maximum** | 70.6 | 70.1 | 71.6 | 71.2 | 71.7 | 70.9 | 71.8 | 71.6 |
| **% Saturation, Minimum** | 69.0 | 68.0 | 70.2 | 69.5 | 69.3 | 70.1 | 69.3 | 69.6 |
| **% Saturation, Range** | 1.6 | 2.1 | 1.4 | 1.7 | 2.4 | 0.8 | 2.5 | 2.0 |
| **% Sat, Avg, Set A & B** | 69.4 | | 70.6 | | 70.7 | | 70.7 | |
| **% Sat, STDEV, Set A & B** | 0.9 | | 0.8 | | 0.8 | | 1.1 | |
| **% Sat, Maximum, Set A & B** | 70.6 | | 71.6 | | 71.7 | | 71.8 | |
| **% Sat, Minimum, Set A & B** | 68.0 | | 69.5 | | 69.3 | | 69.3 | |
| **% Sat, Range, Set A & B** | 2.6 | | 2.1 | | 2.4 | | 2.5 | |
| **Uncond Strength, Average** | 173.9 | 160.9 | 122.6 | 124.0 | 104.7 | 124.1 | 81.5 | 86.0 |
| **Uncond Strength, STDEV** | 7.7 | 4.5 | 0.8 | 2.9 | 17.5 | 5.7 | 7.0 | 3.7 |
| **Uncond Strength, MAX** | 182.8 | 165.5 | 123.1 | 127.3 | 122.5 | 130.4 | 87.2 | 89.0 |
| **Uncond Strength, MIN** | 168.7 | 156.6 | 121.7 | 121.7 | 87.5 | 119.4 | 73.7 | 81.9 |
| **Uncond Strength, Range** | 14.1 | 9.0 | 1.4 | 5.6 | 35.0 | 11.0 | 13.5 | 7.1 |
| **Uncond Str, Avg, Set A & B** | 167.4 | | 123.3 | | 114.4 | | 83.8 | |
| **Unc Str, STDEV, Set A & B** | 9.1 | | 2.1 | | 15.8 | | 5.6 | |
| **Uncnd Str, MAX, Set A & B** | 182.8 | | 127.3 | | 130.4 | | 89.0 | |
| **Uncnd Str, MIN, Set A & B** | 156.6 | | 121.7 | | 87.5 | | 73.7 | |
| **Unc Str, Range, Set A & B** | 26.2 | | 5.6 | | 42.9 | | 15.3 | |
| **Cond Strength, Average** | 97.6 | 96.9 | 87.7 | 87.3 | 82.4 | 84.5 | 62.9 | 64.2 |
| **Cond Strength, STDEV** | 5.2 | 6.6 | 2.8 | 5.0 | 10.7 | 10.9 | 3.8 | 5.1 |
| **Cond Strength, MAX** | 102.7 | 104.5 | 90.5 | 92.0 | 94.7 | 96.3 | 67.2 | 70.1 |
| **Cond Strength, MIN** | 92.3 | 92.3 | 84.9 | 82.1 | 76.1 | 74.8 | 60.1 | 60.7 |
| **Cond Strength, Range** | 10.4 | 12.2 | 5.6 | 9.9 | 18.6 | 21.5 | 7.1 | 9.4 |
| **Cond Str, Avg, Set A & B** | 97.2 | | 87.5 | | 83.4 | | 63.6 | |
| **Cond Str, STDEV, Set A & B** | 5.3 | | 3.6 | | 9.7 | | 4.1 | |
| **Cond Str, MAX, Set A & B** | 104.5 | | 92.0 | | 96.3 | | 70.1 | |
| **Cond Str, MIN, Set A & B** | 92.3 | | 82.1 | | 74.8 | | 60.1 | |
| **Cond Str, Range, Set A & B** | 12.2 | | 9.9 | | 21.5 | | 10.0 | |
| **TSR** | 0.561 | 0.602 | 0.715 | 0.704 | 0.787 | 0.681 | 0.771 | 0.747 |
| **TSR, Set A & B** | 0.581 | | 0.709 | | 0.729 | | 0.759 | |
| TSR DIFFERENCE, 6" - 4" | 0.129 | | | | 0.029 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **038ReTest** |
| **District Number** | District 6 |
| **Mix Design Number** | 86BIT3069 |
| **Material Code** | 19513M |
| **Type Mix** | Bit Conc Surface Course Type 2 C, N50 |
| **District Gmm** | 2.447 |
| **Producer** | Illinois Valley Paving Company |
| **P/S Number** | 943-26 |
| **Location** | Winchester |
| **Contract Number** | |
| **Date Sampled** | 08/09/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N50 |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 032CMM16 |
| **Name of Coarse #1** | Crushed Limestone |
| **% of Coarse #1** | 68.3 (Produced @ 71.0 %) |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FMM21 |
| **Name Fine #1** | Crushed Limestone Sand |
| **% Fine #1** | 18.0 (Produced @ 15.0 %) |
| **Fine Aggregate #2** | 037FAM01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 12.8 (produced @ 14.0 %) |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 0.9 in design, (Produced @ 0.0 %) |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.0 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.81 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **038ReTest** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.295 | 2.317 | 2.295 | 2.298 | 2.285 | 2.280 | 2.298 | 2.299 |
| **Gmb, Sample 2** | 2.305 | 2.308 | 2.305 | 2.301 | 2.288 | 2.288 | 2.302 | 2.294 |
| **Gmb, Sample 3** | 2.310 | 2.309 | 2.290 | 2.296 | 2.297 | 2.281 | 2.287 | 2.289 |
| **Gmb, Sample 4** | 2.311 | 2.298 | 2.292 | 2.299 | 2.272 | 2.297 | 2.292 | 2.291 |
| **Gmb, Sample 5** | 2.309 | 2.302 | 2.297 | 2.302 | 2.282 | 2.285 | 2.288 | 2.289 |
| **Gmb, Sample 6** | 2.312 | 2.305 | 2.293 | 2.295 | 2.282 | 2.275 | 2.288 | 2.289 |
| **Gmb, Average** | **2.307** | **2.307** | **2.295** | **2.299** | **2.284** | **2.284** | **2.293** | **2.292** |
| **Gmb, Average Set A & B** | **2.307** | | **2.297** | | **2.284** | | **2.292** | |
| **BMPR Gmm** | 2.477 | | 2.477 | | 2.461 | | 2.461 | |
| **Voids, Sample 1** | 7.3 | 6.5 | 7.3 | 7.2 | 7.2 | 7.4 | 6.6 | 6.6 |
| **Voids, Sample 2** | 6.9 | 6.8 | 6.9 | 7.1 | 7.0 | 7.0 | 6.5 | 6.8 |
| **Voids, Sample 3** | 6.7 | 6.8 | 7.5 | 7.3 | 6.7 | 7.3 | 7.1 | 7.0 |
| **Voids, Sample 4** | 6.7 | 7.2 | 7.5 | 7.2 | 7.7 | 6.7 | 6.9 | 6.9 |
| **Voids, Sample 5** | 6.8 | 7.1 | 7.3 | 7.1 | 7.3 | 7.2 | 7.0 | 7.0 |
| **Voids, Sample 6** | 6.7 | 6.9 | 7.4 | 7.3 | 7.3 | 7.6 | 7.0 | 7.0 |
| **Voids, Average** | **6.9** | **6.9** | **7.3** | **7.2** | **7.2** | **7.2** | **6.9** | **6.9** |
| **Voids, Average Set A & B** | **6.9** | | **7.3** | | **7.2** | | **6.9** | |
| **% Saturated, Sample 1** | 70.6 | 68.0 | | | 68.4 | | 70.7 | |
| **% Saturated, Sample 2** | | | 70.2 | | 70.6 | 69.7 | | 68.6 |
| **% Saturated, Sample 3** | | | 70.2 | | | 69.8 | | 70.9 |
| **% Saturated, Sample 4** | 69.0 | 70.1 | | 71.2 | | | 70.1 | 70.9 |
| **% Saturated, Sample 5** | | | | 71.0 | 70.3 | 70.7 | | |
| **% Saturated, Sample 6** | 69.6 | 68.8 | 71.6 | 69.5 | | | 71.5 | |
| **Average % Saturation** | **69.7** | **69.0** | **70.7** | **70.6** | **69.8** | **70.1** | **70.8** | **70.1** |
| **Avg. % Sat. Set A & B** | **69.4** | | **70.6** | | **69.9** | | **70.5** | |
| **Cond or Uncond, Sample 1** | Cond | Cond | Uncond | Uncond | Cond | Uncond | Cond | Uncond |
| **Cond or Uncond, Sample 2** | Uncond | Uncond | Cond | Uncond | Cond | Cond | Uncond | Cond |
| **Cond or Uncond, Sample 3** | Uncond | Uncond | Cond | Uncond | Uncond | Cond | Uncond | Cond |
| **Cond or Uncond, Sample 4** | Cond | Cond | Uncond | Cond | Uncond | Uncond | Cond | Cond |
| **Cond or Uncond, Sample 5** | Uncond | Uncond | Uncond | Cond | Cond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | Cond | Cond | Cond | Cond | Uncond | Uncond | Cond | Uncond |
| **Uncond Strength, Sample 1** | | | 121.7 | 123.1 | | 87.0 | | 65.5 |
| **Cond Strength, Sample 1** | 92.3 | 104.5 | | | 74.5 | | 65.4 | |
| **Uncond Strength, Sample 2** | 170.3 | 156.6 | | 127.3 | | | 64.9 | |
| **Cond Strength, Sample 2** | | | 90.5 | | 73.2 | 73.2 | | 62.5 |
| **Uncond Strength, Sample 3** | 182.8 | 165.5 | | 121.7 | 92.3 | | 66.1 | |
| **Cond Strength, Sample 3** | | | 84.9 | | | 79.6 | | 57.5 |
| **Uncond Strength, Sample 4** | | | 123.1 | | 91.6 | 100.3 | | |
| **Cond Strength, Sample 4** | 97.8 | 92.3 | | 82.1 | | | 62.6 | 59.2 |
| **Uncond Strength, Sample 5** | 168.7 | 160.8 | 123.1 | | | | 58.0 | 67.2 |
| **Cond Strength, Sample 5** | | | | 87.7 | 76.4 | 73.2 | | |
| **Uncond Strength, Sample 6** | | | | | 84.4 | 81.2 | | 66.9 |
| **Cond Strength, Sample 6** | 102.7 | 93.9 | 87.7 | 92.0 | | | 61.2 | |
| **Average Uncond Strength** | **173.9** | **160.9** | **122.6** | **124.0** | **89.4** | **89.5** | **63.0** | **66.5** |
| **Avg Uncond Str., Set A & B** | **167.4** | | **123.3** | | **89.5** | | **64.8** | |
| **Average Cond Strength** | **97.6** | **96.9** | **87.7** | **87.3** | **74.7** | **75.3** | **63.1** | **59.7** |
| **Avg Cond Str., Set A & B** | **97.2** | | **87.5** | | **75.0** | | **61.4** | |
| **Avg Uncond Str. w/Additive** | | | | | 89.4 | 89.5 | 63.0 | 66.5 |
| **Avg Cond Str. w/Additive** | | | | | 74.7 | 75.3 | 63.1 | 59.7 |
| **TSR** | **0.561** | **0.602** | **0.715** | **0.704** | **0.835** | **0.842** | **1.001** | **0.898** |
| **TSR, Set A & B** | **0.581** | | **0.709** | | **0.838** | | **0.948** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **038ReTest** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.307 | 2.307 | 2.295 | 2.299 | 2.284 | 2.284 | 2.293 | 2.292 |
| **Gmb, Standard Deviation** | 0.0064 | 0.0065 | 0.0053 | 0.0027 | 0.0082 | 0.0076 | 0.0062 | 0.0040 |
| **Gmb, Maximum** | 2.312 | 2.317 | 2.305 | 2.302 | 2.297 | 2.297 | 2.302 | 2.299 |
| **Gmb, Minimum** | 2.295 | 2.298 | 2.290 | 2.295 | 2.272 | 2.275 | 2.287 | 2.289 |
| **Gmb, Range** | 0.017 | 0.019 | 0.015 | 0.007 | 0.025 | 0.022 | 0.015 | 0.010 |
| **Gmb, Average, Set A & B** | 2.307 | | 2.297 | | 2.284 | | 2.292 | |
| **Gmb, STDEV, Set A & B** | 0.0062 | | 0.0044 | | 0.0076 | | 0.0050 | |
| **Gmb, Maximum, Set A & B** | 2.317 | | 2.305 | | 2.297 | | 2.302 | |
| **Gmb, Minimum, Set A & B** | 2.295 | | 2.290 | | 2.272 | | 2.287 | |
| **Gmb, Range Set, A & B** | 0.022 | | 0.015 | | 0.025 | | 0.015 | |
| **Voids, Average** | 6.9 | 6.9 | 7.3 | 7.2 | 7.2 | 7.2 | 6.9 | 6.9 |
| **Voids, Standard Deviation** | 0.23 | 0.25 | 0.22 | 0.09 | 0.33 | 0.32 | 0.24 | 0.16 |
| **Voids, Maximum** | 7.3 | 7.2 | 7.5 | 7.3 | 7.7 | 7.6 | 7.1 | 7.0 |
| **Voids, Minimum** | 6.7 | 6.5 | 6.9 | 7.1 | 6.7 | 6.7 | 6.5 | 6.6 |
| **Voids, Range** | 0.6 | 0.7 | 0.6 | 0.2 | 1.0 | 0.9 | 0.6 | 0.4 |
| **Voids, Average Set A & B** | 6.9 | | 7.3 | | 7.2 | | 6.9 | |
| **Voids, STDEV, Set A & B** | 0.23 | | 0.17 | | 0.31 | | 0.20 | |
| **Voids, Maximum, Set A & B** | 7.3 | | 7.5 | | 7.7 | | 7.1 | |
| **Voids, Minimun, Set & B** | 6.5 | | 6.9 | | 6.7 | | 6.5 | |
| **Voids, Range, Set A & B** | 0.8 | | 0.6 | | 1.0 | | 0.6 | |
| **% Saturation, Average** | 69.7 | 69.0 | 70.7 | 70.6 | 69.8 | 70.1 | 70.8 | 70.1 |
| **% Saturation, STDEV** | 0.8 | 1.1 | 0.8 | 0.9 | 1.2 | 0.6 | 0.7 | 1.3 |
| **% Saturation, Maximum** | 70.6 | 70.1 | 71.6 | 71.2 | 70.6 | 70.7 | 71.5 | 70.9 |
| **% Saturation, Minimum** | 69.0 | 68.0 | 70.2 | 69.5 | 68.4 | 69.7 | 70.1 | 68.6 |
| **% Saturation, Range** | 1.6 | 2.1 | 1.4 | 1.7 | 2.2 | 1.0 | 1.4 | 2.3 |
| **% Sat, Avg, Set A & B** | 69.4 | | 70.6 | | 69.9 | | 70.5 | |
| **% Sat, STDEV, Set A & B** | 0.9 | | 0.8 | | 0.8 | | 1.0 | |
| **% Sat, Maximum, Set A & B** | 70.6 | | 71.6 | | 70.7 | | 71.5 | |
| **% Sat, Minimum, Set A & B** | 68.0 | | 69.5 | | 68.4 | | 68.6 | |
| **% Sat, Range, Set A & B** | 2.6 | | 2.1 | | 2.3 | | 2.9 | |
| **Uncond Strength, Average** | 173.9 | 160.9 | 122.6 | 124.0 | 89.4 | 89.5 | 63.0 | 66.5 |
| **Uncond Strength, STDEV** | 7.7 | 4.5 | 0.8 | 2.9 | 4.4 | 9.8 | 4.4 | 0.9 |
| **Uncond Strength, MAX** | 182.8 | 165.5 | 123.1 | 127.3 | 92.3 | 100.3 | 66.1 | 67.2 |
| **Uncond Strength, MIN** | 168.7 | 156.6 | 121.7 | 121.7 | 84.4 | 81.2 | 58.0 | 65.5 |
| **Uncond Strength, Range** | 14.1 | 9.0 | 1.4 | 5.6 | 7.9 | 19.1 | 8.1 | 1.7 |
| **Uncond Str, Avg, Set A & B** | 167.4 | | 123.3 | | 89.5 | | 64.8 | |
| **Unc Str, STDEV, Set A & B** | 9.1 | | 2.1 | | 6.8 | | 3.4 | |
| **Uncnd Str, MAX, Set A & B** | 182.8 | | 127.3 | | 100.3 | | 67.2 | |
| **Uncnd Str, MIN, Set A & B** | 156.6 | | 121.7 | | 81.2 | | 58.0 | |
| **Unc Str, Range, Set A & B** | 26.2 | | 5.6 | | 19.1 | | 9.2 | |
| **Cond Strength, Average** | 97.6 | 96.9 | 87.7 | 87.3 | 74.7 | 75.3 | 63.1 | 59.7 |
| **Cond Strength, STDEV** | 5.2 | 6.6 | 2.8 | 5.0 | 1.6 | 3.7 | 2.1 | 2.5 |
| **Cond Strength, MAX** | 102.7 | 104.5 | 90.5 | 92.0 | 76.4 | 79.6 | 65.4 | 62.5 |
| **Cond Strength, MIN** | 92.3 | 92.3 | 84.9 | 82.1 | 73.2 | 73.2 | 61.2 | 57.5 |
| **Cond Strength, Range** | 10.4 | 12.2 | 5.6 | 9.9 | 3.2 | 6.4 | 4.2 | 5.0 |
| **Cond Str, Avg, Set A & B** | 97.2 | | 87.5 | | 75.0 | | 61.4 | |
| **Cond Str, STDEV, Set A & B** | 5.3 | | 3.6 | | 2.6 | | 2.8 | |
| **Cond Str, MAX, Set A & B** | 104.5 | | 92.0 | | 79.6 | | 65.4 | |
| **Cond Str, MIN, Set A & B** | 92.3 | | 82.1 | | 73.2 | | 57.5 | |
| **Cond Str, Range, Set A & B** | 12.2 | | 9.9 | | 6.4 | | 7.9 | |
| **TSR** | 0.561 | 0.602 | 0.715 | 0.704 | 0.835 | 0.842 | 1.001 | 0.898 |
| **TSR, Set A & B** | 0.581 | | 0.709 | | 0.838 | | 0.948 | |
| TSR DIFFERENCE, 6" - 4" | 0.129 | | | | 0.110 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **229** |
| **District Number** | District 7 |
| **Mix Design Number** | 87BIT7203 |
| **Material Code** | 19513 |
| **Type Mix** | Bit Conc Surface Course Type C 50 |
| **District Gmm** | 2.43 |
| **Producer** | Wabash Asphalt Company |
| **P/S Number** | 2052-03 |
| **Location** | Maud |
| **Contract Number** | 94610 |
| **Date Sampled** | 10/12/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N50 |
| **Nominal Maximum Size** | 9.5 mm |
| **Coarse Aggregate #1** | 032CMM16 |
| **Name of Coarse #1** | Crushed Limestone |
| **% of Coarse #1** | 65.0 |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 037FAM01 |
| **Name Fine #1** | Natural Sand |
| **% Fine #1** | 31.5 |
| **Fine Aggregate #2** | |
| **Name Fine #2** | |
| **% Fine #2** | |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 3.5 |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.0 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.76 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **229** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.301 | 2.304 | 2.299 | 2.306 | 2.279 | 2.277 | 2.287 | 2.291 |
| **Gmb, Sample 2** | 2.311 | 2.307 | 2.309 | 2.310 | 2.273 | 2.280 | 2.298 | 2.303 |
| **Gmb, Sample 3** | 2.302 | 2.318 | 2.312 | 2.311 | 2.288 | 2.285 | 2.307 | 2.296 |
| **Gmb, Sample 4** | 2.316 | 2.306 | 2.301 | 2.310 | 2.279 | 2.269 | 2.294 | 2.295 |
| **Gmb, Sample 5** | 2.306 | 2.299 | 2.310 | 2.312 | 2.278 | 2.269 | 2.298 | 2.301 |
| **Gmb, Sample 6** | 2.307 | 2.304 | 2.312 | 2.320 | 2.284 | 2.311 | 2.300 | 2.297 |
| **Gmb, Average** | **2.307** | **2.306** | **2.307** | **2.312** | **2.280** | **2.282** | **2.297** | **2.297** |
| **Gmb, Average Set A & B** | **2.307** | | **2.309** | | **2.281** | | **2.297** | |
| **BMPR Gmm** | 2.483 | | 2.483 | | 2.461 | | 2.459 | |
| **Voids, Sample 1** | 7.3 | 7.3 | 7.4 | 7.1 | 7.4 | 7.5 | 7.0 | 6.8 |
| **Voids, Sample 2** | 6.9 | 7.1 | 7.0 | 7.0 | 7.6 | 7.4 | 6.5 | 6.3 |
| **Voids, Sample 3** | 7.3 | 6.7 | 6.9 | 6.9 | 7.0 | 7.2 | 6.2 | 6.6 |
| **Voids, Sample 4** | 6.7 | 7.1 | 7.3 | 7.0 | 7.4 | 7.8 | 6.7 | 6.7 |
| **Voids, Sample 5** | 7.1 | 7.4 | 7.0 | 6.9 | 7.4 | 7.8 | 6.5 | 6.4 |
| **Voids, Sample 6** | 7.1 | 7.2 | 6.9 | 6.6 | 7.2 | 6.1 | 6.5 | 6.6 |
| **Voids, Average** | **7.1** | **7.1** | **7.1** | **6.9** | **7.3** | **7.3** | **6.6** | **6.6** |
| **Voids, Average Set A & B** | **7.1** | | **7.0** | | **7.3** | | **6.6** | |
| **% Saturated, Sample 1** | 70.8 | 68.6 | | | 70.9 | 71.8 | 71.5 | 71.1 |
| **% Saturated, Sample 2** | | | 70.9 | | 71.0 | 71.3 | 71.7 | 71.4 |
| **% Saturated, Sample 3** | 68.6 | 71.0 | 71.5 | | 71.1 | 71.3 | 71.9 | 70.9 |
| **% Saturated, Sample 4** | 70.6 | | 71.6 | | | | | |
| **% Saturated, Sample 5** | | 71.5 | | | | | | |
| **% Saturated, Sample 6** | | | | | | | | |
| **Average % Saturation** | **70.0** | **70.4** | **71.3** | **#DIV/0!** | **71.0** | **71.5** | **71.7** | **71.1** |
| **Avg. % Sat. Set A & B** | **70.2** | | **71.3** | | **71.2** | | **71.4** | |
| **Cond or Uncond, Sample 1** | Cond | Cond | Uncond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 2** | Uncond | Uncond | Cond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 3** | Cond | Cond | Cond | Uncond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 4** | Cond | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | Uncond | Uncond | Uncond | Cond | Uncond | Uncond | Uncond | Uncond |
| **Uncond Strength, Sample 1** | | | 123.1 | | | | | |
| **Cond Strength, Sample 1** | 121.0 | 121.0 | | 106.1 | 79.6 | 79.6 | 71.3 | 70.7 |
| **Uncond Strength, Sample 2** | 162.3 | 146.4 | | | | | | |
| **Cond Strength, Sample 2** | | | 110.3 | 108.9 | 76.4 | 82.8 | 65.7 | 74.9 |
| **Uncond Strength, Sample 3** | | | | 131.6 | | | | |
| **Cond Strength, Sample 3** | 124.1 | 133.7 | 104.7 | | 82.8 | 84.4 | 67.8 | 69.9 |
| **Uncond Strength, Sample 4** | | 146.4 | | 128.7 | 95.5 | 103.5 | 84.0 | 81.9 |
| **Cond Strength, Sample 4** | 127..3 | | 99.0 | | | | | |
| **Uncond Strength, Sample 5** | 149.6 | | 121.7 | 130.2 | 95.5 | 103.5 | 82.6 | 76.3 |
| **Cond Strength, Sample 5** | | 111.4 | | | | | | |
| **Uncond Strength, Sample 6** | 159.2 | 156.0 | 118.8 | | 103.5 | 105.0 | 81.9 | 82.7 |
| **Cond Strength, Sample 6** | | | | 116.0 | | | | |
| **Average Uncond Strength** | **157.0** | **149.6** | **121.2** | **130.2** | **98.2** | **104.0** | **82.8** | **80.3** |
| **Avg Uncond Str., Set A & B** | **153.3** | | **125.7** | | **101.1** | | **81.6** | |
| **Average Cond Strength** | **122.6** | **122.0** | **104.7** | **110.3** | **79.6** | **82.3** | **68.3** | **71.8** |
| **Avg Cond Str., Set A & B** | **122.2** | | **107.5** | | **80.9** | | **70.1** | |
| **Avg Uncond Str. w/Additive** | | | | | 98.2 | 104.0 | 82.8 | 80.3 |
| **Avg Cond Str. w/Additive** | | | | | 79.6 | 82.3 | 68.3 | 71.8 |
| **TSR** | **0.780** | **0.816** | **0.864** | **0.848** | **0.811** | **0.791** | **0.824** | **0.895** |
| **TSR, Set A & B** | **0.797** | | **0.855** | | **0.801** | | **0.859** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **229** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.307 | 2.306 | 2.307 | 2.312 | 2.280 | 2.282 | 2.297 | 2.297 |
| **Gmb, Standard Deviation** | 0.0056 | 0.0063 | 0.0057 | 0.0046 | 0.0052 | 0.0156 | 0.0066 | 0.0043 |
| **Gmb, Maximum** | 2.316 | 2.318 | 2.312 | 2.320 | 2.288 | 2.311 | 2.307 | 2.303 |
| **Gmb, Minimum** | 2.301 | 2.299 | 2.299 | 2.306 | 2.273 | 2.269 | 2.287 | 2.291 |
| **Gmb, Range** | 0.015 | 0.019 | 0.013 | 0.014 | 0.015 | 0.042 | 0.020 | 0.012 |
| **Gmb, Average, Set A & B** | 2.307 | | 2.309 | | 2.281 | | 2.297 | |
| **Gmb, STDEV, Set A & B** | 0.0057 | | 0.0054 | | 0.0111 | | 0.0053 | |
| **Gmb, Maximum, Set A & B** | 2.318 | | 2.320 | | 2.311 | | 2.307 | |
| **Gmb, Minimum, Set A & B** | 2.299 | | 2.299 | | 2.269 | | 2.287 | |
| **Gmb, Range Set, A & B** | 0.019 | | 0.021 | | 0.042 | | 0.020 | |
| **Voids, Average** | 7.1 | 7.1 | 7.1 | 6.9 | 7.3 | 7.3 | 6.6 | 6.6 |
| **Voids, Standard Deviation** | 0.23 | 0.24 | 0.21 | 0.17 | 0.21 | 0.63 | 0.27 | 0.19 |
| **Voids, Maximum** | 7.3 | 7.4 | 7.4 | 7.1 | 7.6 | 7.8 | 7.0 | 6.8 |
| **Voids, Minimum** | 6.7 | 6.7 | 6.9 | 6.6 | 7.0 | 6.1 | 6.2 | 6.3 |
| **Voids, Range** | 0.6 | 0.7 | 0.5 | 0.5 | 0.6 | 1.7 | 0.8 | 0.5 |
| **Voids, Average Set A & B** | 7.1 | | 7.0 | | 7.3 | | 6.6 | |
| **Voids, STDEV, Set A & B** | 0.23 | | 0.20 | | 0.45 | | 0.22 | |
| **Voids, Maximum, Set A & B** | 7.4 | | 7.4 | | 7.8 | | 7.0 | |
| **Voids, Minimun, Set & B** | 6.7 | | 6.6 | | 6.1 | | 6.2 | |
| **Voids, Range, Set A & B** | 0.7 | | 0.8 | | 1.7 | | 0.8 | |
| **% Saturation, Average** | 70.0 | 70.4 | 71.3 | #DIV/0! | 71.0 | 71.5 | 71.7 | 71.1 |
| **% Saturation, STDEV** | 1.2 | 1.6 | 0.4 | #DIV/0! | 0.1 | 0.3 | 0.2 | 0.3 |
| **% Saturation, Maximum** | 70.8 | 71.5 | 71.6 | 0.0 | 71.1 | 71.8 | 71.9 | 71.4 |
| **% Saturation, Minimum** | 68.6 | 68.6 | 70.9 | 0.0 | 70.9 | 71.3 | 71.5 | 70.9 |
| **% Saturation, Range** | 2.2 | 2.9 | 0.7 | 0.0 | 0.2 | 0.5 | 0.4 | 0.5 |
| **% Sat, Avg, Set A & B** | 70.2 | | 71.3 | | 71.2 | | 71.4 | |
| **% Sat, STDEV, Set A & B** | 1.3 | | 0.4 | | 0.3 | | 0.4 | |
| **% Sat, Maximum, Set A & B** | 71.5 | | 71.6 | | 71.8 | | 71.9 | |
| **% Sat, Minimum, Set A & B** | 68.6 | | 70.9 | | 70.9 | | 70.9 | |
| **% Sat, Range, Set A & B** | 2.9 | | 0.7 | | 0.9 | | 1.0 | |
| **Uncond Strength, Average** | 157.0 | 149.6 | 121.2 | 130.2 | 98.2 | 104.0 | 82.8 | 80.3 |
| **Uncond Strength, STDEV** | 6.6 | 5.5 | 2.2 | 1.5 | 4.6 | 0.9 | 1.1 | 3.5 |
| **Uncond Strength, MAX** | 162.3 | 156.0 | 123.1 | 131.6 | 103.5 | 105.0 | 84.0 | 82.7 |
| **Uncond Strength, MIN** | 149.6 | 146.4 | 118.8 | 128.7 | 95.5 | 103.5 | 81.9 | 76.3 |
| **Uncond Strength, Range** | 12.7 | 9.6 | 4.3 | 2.9 | 8.0 | 1.5 | 2.1 | 6.4 |
| **Uncond Str, Avg, Set A & B** | 153.3 | | 125.7 | | 101.1 | | 81.6 | |
| **Unc Str, STDEV, Set A & B** | 6.8 | | 5.2 | | 4.4 | | 2.7 | |
| **Uncnd Str, MAX, Set A & B** | 162.3 | | 131.6 | | 105.0 | | 84.0 | |
| **Uncnd Str, MIN, Set A & B** | 146.4 | | 118.8 | | 95.5 | | 76.3 | |
| **Unc Str, Range, Set A & B** | 15.9 | | 12.8 | | 9.5 | | 7.7 | |
| **Cond Strength, Average** | 122.6 | 122.0 | 104.7 | 110.3 | 79.6 | 82.3 | 68.3 | 71.8 |
| **Cond Strength, STDEV** | 2.2 | 11.2 | 5.7 | 5.1 | 3.2 | 2.4 | 2.8 | 2.7 |
| **Cond Strength, MAX** | 124.1 | 133.7 | 110.3 | 116.0 | 82.8 | 84.4 | 71.3 | 74.9 |
| **Cond Strength, MIN** | 121.0 | 111.4 | 99.0 | 106.1 | 76.4 | 79.6 | 65.7 | 69.9 |
| **Cond Strength, Range** | 3.1 | 22.3 | 11.3 | 9.9 | 6.4 | 4.8 | 5.6 | 5.0 |
| **Cond Str, Avg, Set A & B** | 122.2 | | 107.5 | | 80.9 | | 70.1 | |
| **Cond Str, STDEV, Set A & B** | 8.0 | | 5.7 | | 2.9 | | 3.1 | |
| **Cond Str, MAX, Set A & B** | 133.7 | | 116.0 | | 84.4 | | 74.9 | |
| **Cond Str, MIN, Set A & B** | 111.4 | | 99.0 | | 76.4 | | 65.7 | |
| **Cond Str, Range, Set A & B** | 22.3 | | 17.0 | | 8.0 | | 9.2 | |
| **TSR** | 0.780 | 0.816 | 0.864 | 0.848 | 0.811 | 0.791 | 0.824 | 0.895 |
| **TSR, Set A & B** | 0.797 | | 0.855 | | 0.801 | | 0.859 | |
| TSR DIFFERENCE, 6" - 4" | 0.058 | | | | 0.058 | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **230** |
| **District Number** | District 3 |
| **Mix Design Number** | 83BIT009Z |
| **Material Code** | 19524M |
| **Type Mix** | Superpave Surface, Mix D, N70 |
| **District Gmm** | 2.486 |
| **Producer** | Azzarelli Construction |
| **P/S Number** | 154-13 |
| **Location** | Manteno |
| **Contract Number** | 66018 |
| **Date Sampled** | 10/13/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N70 |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 032CMM16 |
| **Name of Coarse #1** | Crushed Dolomite |
| **% of Coarse #1** | 62.5% (Produced @ 65.0 %) |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FMM21 |
| **Name Fine #1** | Crushed Dolomite Sand |
| **% Fine #1** | 9.0 % in Design (NONE Produced) |
| **Fine Aggregate #2** | 038FMM20 |
| **Name Fine #2** | Crushed Dolomite Sand |
| **% Fine #2** | 10.0 % in Design (17.5 % Produced) |
| **Fine Aggregate #3** | 037FAM01 |
| **Name Fine #3** | Natural Sand |
| **% Fine #3** | 18.5 % in Design (17.5 % Produced) |
| **Mineral Filler** | |
| **Name of MF** | |
| **% of MF** | |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.7 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.81at Contractor (0.65 at IDOT District 3) |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **230** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.290 | 2.286 | 2.301 | 2.300 | 2.272 | 2.295 | 2.299 | 2.285 |
| **Gmb, Sample 2** | 2.289 | 2.284 | 2.299 | 2.301 | 2.294 | 2.290 | 2.294 | 2.286 |
| **Gmb, Sample 3** | 2.293 | 2.293 | 2.303 | 2.302 | 2.290 | 2.282 | 2.291 | 2.292 |
| **Gmb, Sample 4** | 2.285 | 2.287 | 2.297 | 2.293 | 2.287 | 2.289 | 2.277 | 2.292 |
| **Gmb, Sample 5** | 2.288 | 2.290 | 2.303 | 2.304 | 2.286 | 2.287 | 2.282 | 2.288 |
| **Gmb, Sample 6** | 2.287 | 2.282 | 2.299 | 2.296 | 2.294 | 2.278 | 2.289 | 2.291 |
| **Gmb, Average** | **2.289** | **2.287** | **2.300** | **2.299** | **2.287** | **2.287** | **2.289** | **2.289** |
| **Gmb, Average Set A & B** | **2.288** | | **2.300** | | **2.287** | | **2.289** | |
| **BMPR Gmm** | 2.466 | | 2.466 | | 2.457 | | 2.457 | |
| **Voids, Sample 1** | 7.1 | 7.3 | 6.7 | 6.7 | 7.5 | 6.6 | 6.4 | 7.0 |
| **Voids, Sample 2** | 7.2 | 7.4 | 6.8 | 6.7 | 6.6 | 6.8 | 6.6 | 7.0 |
| **Voids, Sample 3** | 7.0 | 7.0 | 6.6 | 6.7 | 6.8 | 7.1 | 6.8 | 6.7 |
| **Voids, Sample 4** | 7.3 | 7.3 | 6.9 | 7.0 | 6.9 | 6.8 | 7.3 | 6.7 |
| **Voids, Sample 5** | 7.2 | 7.1 | 6.6 | 6.6 | 7.0 | 6.9 | 7.1 | 6.9 |
| **Voids, Sample 6** | 7.3 | 7.5 | 6.8 | 6.9 | 6.6 | 7.3 | 6.8 | 6.8 |
| **Voids, Average** | **7.2** | **7.3** | **6.7** | **6.8** | **6.9** | **6.9** | **6.8** | **6.9** |
| **Voids, Average Set A & B** | **7.2** | | **6.8** | | **6.9** | | **6.8** | |
| **% Saturated, Sample 1** | | | 71.1 | | | | | 69.9 |
| **% Saturated, Sample 2** | | 70.9 | | 69.5 | | 70.6 | | |
| **% Saturated, Sample 3** | 68.9 | | 68.3 | | 71.8 | 71.4 | 71.9 | 69.1 |
| **% Saturated, Sample 4** | 71.3 | 69.0 | 68.2 | 71.3 | 70.5 | | | |
| **% Saturated, Sample 5** | 71.5 | 71.2 | | 71.4 | 70.3 | 71.4 | 70.5 | 69.4 |
| **% Saturated, Sample 6** | | | | | | | 70.5 | |
| **Average % Saturation** | **70.6** | **70.4** | **69.2** | **70.7** | **70.9** | **71.1** | **71.0** | **69.5** |
| **Avg. % Sat. Set A & B** | **70.5** | | **70.0** | | **71.0** | | **70.2** | |
| **Cond or Uncond, Sample 1** | Uncond | Uncond | Cond | Uncond | Uncond | Uncond | Uncond | Cond |
| **Cond or Uncond, Sample 2** | Uncond | Cond | Uncond | Cond | Uncond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 3** | Cond | Uncond | Cond | Uncond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 4** | Cond | Cond | Cond | Cond | Cond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 5** | Cond | Cond | Uncond | Cond | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 6** | Uncond | Uncond | Uncond | Uncond | Uncond | Uncond | Cond | Uncond |
| **Uncond Strength, Sample 1** | 156.0 | 151.2 | | 124.5 | 105.6 | 108.2 | 75.5 | |
| **Cond Strength, Sample 1** | | | 116.0 | | | | | 70.5 |
| **Uncond Strength, Sample 2** | 152.8 | | 124.5 | | 111.8 | | 81.3 | 69.8 |
| **Cond Strength, Sample 2** | | 128.9 | | 106.1 | | 73.0 | | |
| **Uncond Strength, Sample 3** | | 152.8 | | 121.7 | | | | |
| **Cond Strength, Sample 3** | 140.1 | | 107.5 | | 76.1 | 76.1 | 71.2 | 64.0 |
| **Uncond Strength, Sample 4** | | | | | | 116.5 | 76.3 | 92.1 |
| **Cond Strength, Sample 4** | 127.3 | 130.5 | 111.8 | 110.3 | 76.1 | | | |
| **Uncond Strength, Sample 5** | | | 117.4 | | | | | |
| **Cond Strength, Sample 5** | 133.7 | 136.9 | | 116.0 | 71.4 | 71.4 | 67.6 | 69.8 |
| **Uncond Strength, Sample 6** | 148.0 | 160.7 | 124.5 | 123.1 | 114.9 | 108.8 | | 80.6 |
| **Cond Strength, Sample 6** | | | | | | | 72.7 | |
| **Average Uncond Strength** | **152.3** | **154.9** | **122.1** | **123.1** | **110.8** | **111.2** | **77.7** | **80.8** |
| **Avg Uncond Str., Set A & B** | **153.6** | | **122.6** | | **111.0** | | **79.3** | |
| **Average Cond Strength** | **133.7** | **132.1** | **111.8** | **110.8** | **74.5** | **73.5** | **70.5** | **68.1** |
| **Avg Cond Str., Set A & B** | **132.9** | | **111.3** | | **74.0** | | **69.3** | |
| **Avg Uncond Str. w/Additive** | | | | | 110.8 | 111.2 | 77.7 | 80.8 |
| **Avg Cond Str. w/Additive** | | | | | 74.5 | 73.5 | 70.5 | 68.1 |
| **TSR** | **0.878** | **0.853** | **0.915** | **0.900** | **0.673** | **0.661** | **0.907** | **0.842** |
| **TSR, Set A & B** | **0.865** | | **0.908** | | **0.667** | | **0.874** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **230** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.289 | 2.287 | 2.300 | 2.299 | 2.287 | 2.287 | 2.289 | 2.289 |
| **Gmb, Standard Deviation** | 0.0027 | 0.0040 | 0.0024 | 0.0041 | 0.0082 | 0.0060 | 0.0080 | 0.0031 |
| **Gmb, Maximum** | 2.293 | 2.293 | 2.303 | 2.304 | 2.294 | 2.295 | 2.299 | 2.292 |
| **Gmb, Minimum** | 2.285 | 2.282 | 2.297 | 2.293 | 2.272 | 2.278 | 2.277 | 2.285 |
| **Gmb, Range** | 0.008 | 0.011 | 0.006 | 0.011 | 0.022 | 0.017 | 0.022 | 0.007 |
| **Gmb, Average, Set A & B** | 2.288 | | 2.300 | | 2.287 | | 2.289 | |
| **Gmb, STDEV, Set A & B** | 0.0034 | | 0.0032 | | 0.0068 | | 0.0058 | |
| **Gmb, Maximum, Set A & B** | 2.293 | | 2.304 | | 2.295 | | 2.299 | |
| **Gmb, Minimum, Set A & B** | 2.282 | | 2.293 | | 2.272 | | 2.277 | |
| **Gmb, Range Set, A & B** | 0.011 | | 0.011 | | 0.023 | | 0.022 | |
| **Voids, Average** | 7.2 | 7.3 | 6.7 | 6.8 | 6.9 | 6.9 | 6.8 | 6.9 |
| **Voids, Standard Deviation** | 0.12 | 0.19 | 0.12 | 0.15 | 0.33 | 0.25 | 0.33 | 0.14 |
| **Voids, Maximum** | 7.3 | 7.5 | 6.9 | 7.0 | 7.5 | 7.3 | 7.3 | 7.0 |
| **Voids, Minimum** | 7.0 | 7.0 | 6.6 | 6.6 | 6.6 | 6.6 | 6.4 | 6.7 |
| **Voids, Range** | 0.3 | 0.5 | 0.3 | 0.4 | 0.9 | 0.7 | 0.9 | 0.3 |
| **Voids, Average Set A & B** | 7.2 | | 6.8 | | 6.9 | | 6.8 | |
| **Voids, STDEV, Set A & B** | 0.15 | | 0.13 | | 0.28 | | 0.24 | |
| **Voids, Maximum, Set A & B** | 7.5 | | 7.0 | | 7.5 | | 7.3 | |
| **Voids, Minimun, Set & B** | 7.0 | | 6.6 | | 6.6 | | 6.4 | |
| **Voids, Range, Set A & B** | 0.5 | | 0.4 | | 0.9 | | 0.9 | |
| **% Saturation, Average** | 70.6 | 70.4 | 69.2 | 70.7 | 70.9 | 71.1 | 71.0 | 69.5 |
| **% Saturation, STDEV** | 1.4 | 1.2 | 1.6 | 1.1 | 0.8 | 0.5 | 0.8 | 0.4 |
| **% Saturation, Maximum** | 71.5 | 71.2 | 71.1 | 71.4 | 71.8 | 71.4 | 71.9 | 69.9 |
| **% Saturation, Minimum** | 68.9 | 69.0 | 68.2 | 69.5 | 70.3 | 70.6 | 70.5 | 69.1 |
| **% Saturation, Range** | 2.6 | 2.2 | 2.9 | 1.9 | 1.5 | 0.8 | 1.4 | 0.8 |
| **% Sat, Avg, Set A & B** | 70.5 | | 70.0 | | 71.0 | | 70.2 | |
| **% Sat, STDEV, Set A & B** | 1.2 | | 1.5 | | 0.6 | | 1.0 | |
| **% Sat, Maximum, Set A & B** | 71.5 | | 71.4 | | 71.8 | | 71.9 | |
| **% Sat, Minimum, Set A & B** | 68.9 | | 68.2 | | 70.3 | | 69.1 | |
| **% Sat, Range, Set A & B** | 2.6 | | 3.2 | | 1.5 | | 2.8 | |
| **Uncond Strength, Average** | 152.3 | 154.9 | 122.1 | 123.1 | 110.8 | 111.2 | 77.7 | 80.8 |
| **Uncond Strength, STDEV** | 4.0 | 5.1 | 4.1 | 1.4 | 4.7 | 4.6 | 3.1 | 11.2 |
| **Uncond Strength, MAX** | 156.0 | 160.7 | 124.5 | 124.5 | 114.9 | 116.5 | 81.3 | 92.1 |
| **Uncond Strength, MIN** | 148.0 | 151.2 | 117.4 | 121.7 | 105.6 | 108.2 | 75.5 | 69.8 |
| **Uncond Strength, Range** | 8.0 | 9.5 | 7.1 | 2.8 | 9.3 | 8.3 | 5.8 | 22.3 |
| **Uncond Str, Avg, Set A & B** | 153.6 | | 122.6 | | 111.0 | | 79.3 | |
| **Unc Str, STDEV, Set A & B** | 4.3 | | 2.8 | | 4.2 | | 7.5 | |
| **Uncnd Str, MAX, Set A & B** | 160.7 | | 124.5 | | 116.5 | | 92.1 | |
| **Uncnd Str, MIN, Set A & B** | 148.0 | | 117.4 | | 105.6 | | 69.8 | |
| **Unc Str, Range, Set A & B** | 12.7 | | 7.1 | | 10.9 | | 22.3 | |
| **Cond Strength, Average** | 133.7 | 132.1 | 111.8 | 110.8 | 74.5 | 73.5 | 70.5 | 68.1 |
| **Cond Strength, STDEV** | 6.4 | 4.2 | 4.3 | 5.0 | 2.7 | 2.4 | 2.6 | 3.6 |
| **Cond Strength, MAX** | 140.1 | 136.9 | 116.0 | 116.0 | 76.1 | 76.1 | 72.7 | 70.5 |
| **Cond Strength, MIN** | 127.3 | 128.9 | 107.5 | 106.1 | 71.4 | 71.4 | 67.6 | 64.0 |
| **Cond Strength, Range** | 12.8 | 8.0 | 8.5 | 9.9 | 4.7 | 4.7 | 5.1 | 6.5 |
| **Cond Str, Avg, Set A & B** | 132.9 | | 111.3 | | 74.0 | | 69.3 | |
| **Cond Str, STDEV, Set A & B** | 4.9 | | 4.2 | | 2.4 | | 3.1 | |
| **Cond Str, MAX, Set A & B** | 140.1 | | 116.0 | | 76.1 | | 72.7 | |
| **Cond Str, MIN, Set A & B** | 127.3 | | 106.1 | | 71.4 | | 64.0 | |
| **Cond Str, Range, Set A & B** | 12.8 | | 9.9 | | 4.7 | | 8.7 | |
| **TSR** | 0.878 | 0.853 | 0.915 | 0.900 | 0.673 | 0.661 | 0.907 | 0.842 |
| **TSR, Set A & B** | 0.865 | | 0.908 | | 0.667 | | 0.874 | |
| TSR DIFFERENCE, 6" - 4" | 0.042 | | | | 0.207 | | | |

# 4-inch -vs- 6-inch TSR Study

| | |
|---|---|
| **Date Data Entered** | |

| General Information | |
|---|---|
| **Lab Number** | **231** |
| **District Number** | District 5 |
| **Mix Design Number** | 85BIT2922 |
| **Material Code** | 19514 |
| **Type Mix** | Bit Conc Surface Course N50 D |
| **District Gmm** | 2.458 |
| **Producer** | Ashford Industries, Inc |
| **P/S Number** | 5257-03 |
| **Location** | Fairmont |
| **Contract Number** | |
| **Date Sampled** | Late October or Early November |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N50 |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 032CMM16 |
| **Name of Coarse #1** | Crushed Limestone |
| **% of Coarse #1** | 32.4 |
| **Coarse Aggregate #2** | 031CMM16 |
| **Name of Coarse #2** | Crushed Gravel |
| **% of Coarse #2** | 31.9 |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 037FAM01 |
| **Name Fine #1** | Natural Sand |
| **% Fine #1** | 32.0 |
| **Fine Aggregate #2** | |
| **Name Fine #2** | |
| **% Fine #2** | |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 3.7 |
| **AC Grade** | |
| **% AC** | 5.4 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.87 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **231** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.313 | 2.306 | 2.301 | 2.298 | | | | |
| **Gmb, Sample 2** | 2.290 | 2.299 | 2.307 | 2.299 | | | | |
| **Gmb, Sample 3** | 2.311 | 2.291 | 2.299 | 2.296 | | | | |
| **Gmb, Sample 4** | 2.301 | 2.289 | 2.299 | 2.299 | | | | |
| **Gmb, Sample 5** | 2.303 | 2.298 | 2.293 | 2.301 | | | | |
| **Gmb, Sample 6** | 2.310 | 2.304 | 2.302 | 2.293 | | | | |
| **Gmb, Average** | **2.305** | **2.298** | **2.300** | **2.298** | | | | |
| **Gmb, Average Set A & B** | **2.301** | | **2.299** | | | | | |
| **BMPR Gmm** | 2.473 | | 2.473 | | | | | |
| **Voids, Sample 1** | 6.5 | 6.8 | 7.0 | 7.1 | | | | |
| **Voids, Sample 2** | 7.4 | 7.0 | 6.7 | 7.0 | | | | |
| **Voids, Sample 3** | 6.6 | 7.4 | 7.0 | 7.2 | | | | |
| **Voids, Sample 4** | 7.0 | 7.4 | 7.0 | 7.0 | | | | |
| **Voids, Sample 5** | 6.9 | 7.1 | 7.3 | 7.0 | | | | |
| **Voids, Sample 6** | 6.6 | 6.8 | 6.9 | 7.3 | | | | |
| **Voids, Average** | **6.8** | **7.1** | **7.0** | **7.1** | | | | |
| **Voids, Average Set A & B** | **7.0** | | **7.0** | | | | | |
| **% Saturated, Sample 1** | 70.2 | | 71.3 | 71.2 | | | | |
| **% Saturated, Sample 2** | 70.2 | | 71.1 | 71.6 | | | | |
| **% Saturated, Sample 3** | 69.7 | 69.9 | | 71.3 | | | | |
| **% Saturated, Sample 4** | | | | | | | | |
| **% Saturated, Sample 5** | | 70.0 | 69.6 | | | | | |
| **% Saturated, Sample 6** | | 71.3 | | | | | | |
| **Average % Saturation** | **70.0** | **70.4** | **70.7** | **71.4** | | | | |
| **Avg. % Sat. Set A & B** | **70.2** | | **71.0** | | | | | |
| **Cond or Uncond, Sample 1** | Cond | Uncond | Cond | Cond | | | | |
| **Cond or Uncond, Sample 2** | Cond | Uncond | Cond | Cond | | | | |
| **Cond or Uncond, Sample 3** | Cond | Cond | Uncond | Cond | | | | |
| **Cond or Uncond, Sample 4** | Uncond | Uncond | Uncond | Uncond | | | | |
| **Cond or Uncond, Sample 5** | Uncond | Cond | Cond | Uncond | | | | |
| **Cond or Uncond, Sample 6** | Uncond | Cond | Uncond | Uncond | | | | |
| **Uncond Strength, Sample 1** | | 128.9 | | | | | | |
| **Cond Strength, Sample 1** | 119.2 | | 87.7 | 84.9 | | | | |
| **Uncond Strength, Sample 2** | | 130.5 | | | | | | |
| **Cond Strength, Sample 2** | 111.4 | | 82.1 | 82.1 | | | | |
| **Uncond Strength, Sample 3** | | | 89.1 | | | | | |
| **Cond Strength, Sample 3** | 114.6 | 127.3 | | 87.7 | | | | |
| **Uncond Strength, Sample 4** | 133.7 | 136.9 | 90.5 | 89.1 | | | | |
| **Cond Strength, Sample 4** | | | | | | | | |
| **Uncond Strength, Sample 5** | 130.5 | | | 89.1 | | | | |
| **Cond Strength, Sample 5** | | 114.6 | 84.9 | | | | | |
| **Uncond Strength, Sample 6** | 130.6 | | 99.0 | 86.3 | | | | |
| **Cond Strength, Sample 6** | | 119.4 | | | | | | |
| **Average Uncond Strength** | **131.6** | **132.1** | **92.9** | **88.2** | | | | |
| **Avg Uncond Str., Set A & B** | **131.9** | | **90.5** | | | | | |
| **Average Cond Strength** | **115.1** | **120.4** | **84.9** | **84.9** | | | | |
| **Avg Cond Str., Set A & B** | **117.8** | | **84.9** | | | | | |
| **Avg Uncond Str. w/Additive** | | | | | | | | |
| **Avg Cond Str. w/Additive** | | | | | | | | |
| **TSR** | **0.874** | **0.912** | **0.914** | **0.963** | | | | |
| **TSR, Set A & B** | **0.893** | | **0.938** | | | | | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **231** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.305 | 2.298 | 2.300 | 2.298 | | | | |
| **Gmb, Standard Deviation** | 0.0086 | 0.0068 | 0.0046 | 0.0028 | | | | |
| **Gmb, Maximum** | 2.313 | 2.306 | 2.307 | 2.301 | | | | |
| **Gmb, Minimum** | 2.290 | 2.289 | 2.293 | 2.293 | | | | |
| **Gmb, Range** | 0.023 | 0.017 | 0.014 | 0.008 | | | | |
| **Gmb, Average, Set A & B** | 2.301 | | 2.299 | | | | | |
| **Gmb, STDEV, Set A & B** | 0.0082 | | 0.0038 | | | | | |
| **Gmb, Maximum, Set A & B** | 2.313 | | 2.307 | | | | | |
| **Gmb, Minimum, Set A & B** | 2.289 | | 2.293 | | | | | |
| **Gmb, Range Set, A & B** | 0.024 | | 0.014 | | | | | |
| **Voids, Average** | 6.8 | 7.1 | 7.0 | 7.1 | | | | |
| **Voids, Standard Deviation** | 0.34 | 0.27 | 0.19 | 0.13 | | | | |
| **Voids, Maximum** | 7.4 | 7.4 | 7.3 | 7.3 | | | | |
| **Voids, Minimum** | 6.5 | 6.8 | 6.7 | 7.0 | | | | |
| **Voids, Range** | 0.9 | 0.6 | 0.6 | 0.3 | | | | |
| **Voids, Average Set A & B** | 7.0 | | 7.0 | | | | | |
| **Voids, STDEV, Set A & B** | 0.32 | | 0.17 | | | | | |
| **Voids, Maximum, Set A & B** | 7.4 | | 7.3 | | | | | |
| **Voids, Minimun, Set & B** | 6.5 | | 6.7 | | | | | |
| **Voids, Range, Set A & B** | 0.9 | | 0.6 | | | | | |
| **% Saturation, Average** | 70.0 | 70.4 | 70.7 | 71.4 | | | | |
| **% Saturation, STDEV** | 0.3 | 0.8 | 0.9 | 0.2 | | | | |
| **% Saturation, Maximum** | 70.2 | 71.3 | 71.3 | 71.6 | | | | |
| **% Saturation, Minimum** | 69.7 | 69.9 | 69.6 | 71.2 | | | | |
| **% Saturation, Range** | 0.5 | 1.4 | 1.7 | 0.4 | | | | |
| **% Sat, Avg, Set A & B** | 70.2 | | 71.0 | | | | | |
| **% Sat, STDEV, Set A & B** | 0.6 | | 0.7 | | | | | |
| **% Sat, Maximum, Set A & B** | 71.3 | | 71.6 | | | | | |
| **% Sat, Minimum, Set A & B** | 69.7 | | 69.6 | | | | | |
| **% Sat, Range, Set A & B** | 1.6 | | 2.0 | | | | | |
| **Uncond Strength, Average** | 131.6 | 132.1 | 92.9 | 88.2 | | | | |
| **Uncond Strength, STDEV** | 1.8 | 4.2 | 5.4 | 1.6 | | | | |
| **Uncond Strength, MAX** | 133.7 | 136.9 | 99.0 | 89.1 | | | | |
| **Uncond Strength, MIN** | 130.5 | 128.9 | 89.1 | 86.3 | | | | |
| **Uncond Strength, Range** | 3.2 | 8.0 | 9.9 | 2.8 | | | | |
| **Uncond Str, Avg, Set A & B** | 131.9 | | 90.5 | | | | | |
| **Unc Str, STDEV, Set A & B** | 2.9 | | 4.4 | | | | | |
| **Uncnd Str, MAX, Set A & B** | 136.9 | | 99.0 | | | | | |
| **Uncnd Str, MIN, Set A & B** | 128.9 | | 86.3 | | | | | |
| **Unc Str, Range, Set A & B** | 8.0 | | 12.7 | | | | | |
| **Cond Strength, Average** | 115.1 | 120.4 | 84.9 | 84.9 | | | | |
| **Cond Strength, STDEV** | 3.9 | 6.4 | 2.8 | 2.8 | | | | |
| **Cond Strength, MAX** | 119.2 | 127.3 | 87.7 | 87.7 | | | | |
| **Cond Strength, MIN** | 111.4 | 114.6 | 82.1 | 82.1 | | | | |
| **Cond Strength, Range** | 7.8 | 12.7 | 5.6 | 5.6 | | | | |
| **Cond Str, Avg, Set A & B** | 117.8 | | 84.9 | | | | | |
| **Cond Str, STDEV, Set A & B** | 5.6 | | 2.5 | | | | | |
| **Cond Str, MAX, Set A & B** | 127.3 | | 87.7 | | | | | |
| **Cond Str, MIN, Set A & B** | 111.4 | | 82.1 | | | | | |
| **Cond Str, Range, Set A & B** | 15.9 | | 5.6 | | | | | |
| **TSR** | 0.874 | 0.912 | 0.914 | 0.963 | | | | |
| **TSR, Set A & B** | 0.893 | | 0.938 | | | | | |
| TSR DIFFERENCE, 6" - 4" | 0.045 | | | | | | | |

# 4-inch -vs- 6-inch TSR Study

| Date Data Entered | |
|---|---|

| General Information | |
|---|---|
| **Lab Number** | **232** |
| **District Number** | District 7 |
| **Mix Design Number** | 87BIT7194 |
| **Material Code** | 19513 |
| **Type Mix** | Bit Conc Surface Course N50 C |
| **District Gmm** | 2.44 |
| **Producer** | Howell Asphalt |
| **P/S Number** | 912-08 |
| **Location** | Vandalia |
| **Contract Number** | 94606 |
| **Date Sampled** | 11/01/2000 |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | N50 |
| **Nominal Maximum Size** | 9.5 mm |
| **Coarse Aggregate #1** | 032CMM16 |
| **Name of Coarse #1** | Crushed Limestone |
| **% of Coarse #1** | 62.0 |
| **Coarse Aggregate #2** | |
| **Name of Coarse #2** | |
| **% of Coarse #2** | |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FAM20 |
| **Name Fine #1** | Crushed Limestone Sand |
| **% Fine #1** | 12.0 |
| **Fine Aggregate #2** | 037FAM01 |
| **Name Fine #2** | Natural Sand |
| **% Fine #2** | 24.0 |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MFM01 |
| **Name of MF** | Limestone Mineral Filler |
| **% of MF** | 2.0 |
| **AC Grade** | PG 64-22 |
| **% AC** | 5.2 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.81 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **232** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | 2.284 | 2.282 | 2.279 | 2.276 | | | | |
| **Gmb, Sample 2** | 2.295 | 2.283 | 2.280 | 2.280 | | | | |
| **Gmb, Sample 3** | 2.294 | 2.280 | 2.280 | 2.278 | | | | |
| **Gmb, Sample 4** | 2.290 | 2.283 | 2.276 | 2.279 | | | | |
| **Gmb, Sample 5** | 2.285 | 2.288 | 2.275 | 2.275 | | | | |
| **Gmb, Sample 6** | 2.283 | 2.283 | 2.278 | 2.273 | | | | |
| **Gmb, Average** | **2.289** | **2.283** | **2.278** | **2.277** | | | | |
| **Gmb, Average Set A & B** | **2.286** | | **2.277** | | | | | |
| **BMPR Gmm** | 2.454 | | 2.454 | | | | | |
| **Voids, Sample 1** | 6.9 | 7.0 | 7.1 | 7.3 | | | | |
| **Voids, Sample 2** | 6.5 | 7.0 | 7.1 | 7.1 | | | | |
| **Voids, Sample 3** | 6.5 | 7.1 | 7.1 | 7.2 | | | | |
| **Voids, Sample 4** | 6.7 | 7.0 | 7.3 | 7.1 | | | | |
| **Voids, Sample 5** | 6.9 | 6.8 | 7.3 | 7.3 | | | | |
| **Voids, Sample 6** | 7.0 | 7.0 | 7.2 | 7.4 | | | | |
| **Voids, Average** | **6.8** | **7.0** | **7.2** | **7.2** | | | | |
| **Voids, Average Set A & B** | **6.9** | | **7.2** | | | | | |
| **% Saturated, Sample 1** | | | 69.7 | | | | | |
| **% Saturated, Sample 2** | 71.4 | 71.5 | 70.6 | 71.8 | | | | |
| **% Saturated, Sample 3** | | | | 69.5 | | | | |
| **% Saturated, Sample 4** | 68.7 | 71.4 | | | | | | |
| **% Saturated, Sample 5** | | | 70.7 | | | | | |
| **% Saturated, Sample 6** | 70.9 | 71.5 | | 71.9 | | | | |
| **Average % Saturation** | **70.3** | **71.5** | **70.3** | **71.1** | | | | |
| **Avg. % Sat. Set A & B** | **70.9** | | **70.7** | | | | | |
| **Cond or Uncond, Sample 1** | Uncond | Uncond | Cond | Uncond | | | | |
| **Cond or Uncond, Sample 2** | Cond | Cond | Cond | Cond | | | | |
| **Cond or Uncond, Sample 3** | Uncond | Uncond | Uncond | Cond | | | | |
| **Cond or Uncond, Sample 4** | Cond | Cond | Uncond | Uncond | | | | |
| **Cond or Uncond, Sample 5** | Uncond | Uncond | Cond | Uncond | | | | |
| **Cond or Uncond, Sample 6** | Cond | Cond | Uncond | Cond | | | | |
| **Uncond Strength, Sample 1** | 152.8 | 143.2 | | 104.7 | | | | |
| **Cond Strength, Sample 1** | | | 101.9 | | | | | |
| **Uncond Strength, Sample 2** | | | | | | | | |
| **Cond Strength, Sample 2** | 146.4 | 136.9 | 99.0 | 99.0 | | | | |
| **Uncond Strength, Sample 3** | 157.6 | 149.6 | 101.9 | | | | | |
| **Cond Strength, Sample 3** | | | | 100.4 | | | | |
| **Uncond Strength, Sample 4** | | | 104.7 | 112.5 | | | | |
| **Cond Strength, Sample 4** | 141.6 | 132.1 | | | | | | |
| **Uncond Strength, Sample 5** | 156.0 | 152.8 | | 106.1 | | | | |
| **Cond Strength, Sample 5** | | | 108.9 | | | | | |
| **Uncond Strength, Sample 6** | | | 108.9 | | | | | |
| **Cond Strength, Sample 6** | 136.9 | 136.9 | | 101.9 | | | | |
| **Average Uncond Strength** | **155.5** | **148.5** | **105.2** | **107.8** | | | | |
| **Avg Uncond Str., Set A & B** | **152.0** | | **106.5** | | | | | |
| **Average Cond Strength** | **141.6** | **135.3** | **103.3** | **100.4** | | | | |
| **Avg Cond Str., Set A & B** | **138.5** | | **101.9** | | | | | |
| **Avg Uncond Str. w/Additive** | | | | | | | | |
| **Avg Cond Str. w/Additive** | | | | | | | | |
| **TSR** | **0.911** | **0.911** | **0.982** | **0.932** | | | | |
| **TSR, Set A & B** | **0.911** | | **0.957** | | | | | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **232** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | 2.289 | 2.283 | 2.278 | 2.277 | | | | |
| **Gmb, Standard Deviation** | 0.0052 | 0.0026 | 0.0021 | 0.0026 | | | | |
| **Gmb, Maximum** | 2.295 | 2.288 | 2.280 | 2.280 | | | | |
| **Gmb, Minimum** | 2.283 | 2.280 | 2.275 | 2.273 | | | | |
| **Gmb, Range** | 0.012 | 0.008 | 0.005 | 0.007 | | | | |
| **Gmb, Average, Set A & B** | 2.286 | | 2.277 | | | | | |
| **Gmb, STDEV, Set A & B** | 0.0048 | | 0.0024 | | | | | |
| **Gmb, Maximum, Set A & B** | 2.295 | | 2.280 | | | | | |
| **Gmb, Minimum, Set A & B** | 2.280 | | 2.273 | | | | | |
| **Gmb, Range Set, A & B** | 0.015 | | 0.007 | | | | | |
| **Voids, Average** | 6.8 | 7.0 | 7.2 | 7.2 | | | | |
| **Voids, Standard Deviation** | 0.22 | 0.10 | 0.10 | 0.12 | | | | |
| **Voids, Maximum** | 7.0 | 7.1 | 7.3 | 7.4 | | | | |
| **Voids, Minimum** | 6.5 | 6.8 | 7.1 | 7.1 | | | | |
| **Voids, Range** | 0.5 | 0.3 | 0.2 | 0.3 | | | | |
| **Voids, Average Set A & B** | 6.9 | | 7.2 | | | | | |
| **Voids, STDEV, Set A & B** | 0.20 | | 0.11 | | | | | |
| **Voids, Maximum, Set A & B** | 7.1 | | 7.4 | | | | | |
| **Voids, Minimun, Set & B** | 6.5 | | 7.1 | | | | | |
| **Voids, Range, Set A & B** | 0.6 | | 0.3 | | | | | |
| **% Saturation, Average** | 70.3 | 71.5 | 70.3 | 71.1 | | | | |
| **% Saturation, STDEV** | 1.4 | 0.1 | 0.6 | 1.4 | | | | |
| **% Saturation, Maximum** | 71.4 | 71.5 | 70.7 | 71.9 | | | | |
| **% Saturation, Minimum** | 68.7 | 71.4 | 69.7 | 69.5 | | | | |
| **% Saturation, Range** | 2.7 | 0.1 | 1.0 | 2.4 | | | | |
| **% Sat, Avg, Set A & B** | 70.9 | | 70.7 | | | | | |
| **% Sat, STDEV, Set A & B** | 1.1 | | 1.0 | | | | | |
| **% Sat, Maximum, Set A & B** | 71.5 | | 71.9 | | | | | |
| **% Sat, Minimum, Set A & B** | 68.7 | | 69.5 | | | | | |
| **% Sat, Range, Set A & B** | 2.8 | | 2.4 | | | | | |
| **Uncond Strength, Average** | 155.5 | 148.5 | 105.2 | 107.8 | | | | |
| **Uncond Strength, STDEV** | 2.4 | 4.9 | 3.5 | 4.2 | | | | |
| **Uncond Strength, MAX** | 157.6 | 152.8 | 108.9 | 112.5 | | | | |
| **Uncond Strength, MIN** | 152.8 | 143.2 | 101.9 | 104.7 | | | | |
| **Uncond Strength, Range** | 4.8 | 9.6 | 7.0 | 7.8 | | | | |
| **Uncond Str, Avg, Set A & B** | 152.0 | | 106.5 | | | | | |
| **Unc Str, STDEV, Set A & B** | 5.1 | | 3.7 | | | | | |
| **Uncnd Str, MAX, Set A & B** | 157.6 | | 112.5 | | | | | |
| **Uncnd Str, MIN, Set A & B** | 143.2 | | 101.9 | | | | | |
| **Unc Str, Range, Set A & B** | 14.4 | | 10.6 | | | | | |
| **Cond Strength, Average** | 141.6 | 135.3 | 103.3 | 100.4 | | | | |
| **Cond Strength, STDEV** | 4.8 | 2.8 | 5.1 | 1.5 | | | | |
| **Cond Strength, MAX** | 146.4 | 136.9 | 108.9 | 101.9 | | | | |
| **Cond Strength, MIN** | 136.9 | 132.1 | 99.0 | 99.0 | | | | |
| **Cond Strength, Range** | 9.5 | 4.8 | 9.9 | 2.9 | | | | |
| **Cond Str, Avg, Set A & B** | 138.5 | | 101.9 | | | | | |
| **Cond Str, STDEV, Set A & B** | 4.9 | | 3.7 | | | | | |
| **Cond Str, MAX, Set A & B** | 146.4 | | 108.9 | | | | | |
| **Cond Str, MIN, Set A & B** | 132.1 | | 99.0 | | | | | |
| **Cond Str, Range, Set A & B** | 14.3 | | 9.9 | | | | | |
| **TSR** | 0.911 | 0.911 | 0.982 | 0.932 | | | | |
| **TSR, Set A & B** | 0.911 | | 0.957 | | | | | |
| TSR DIFFERENCE, 6" - 4" | 0.046 | | | | | | | |

# 4-inch -vs- 6-inch TSR Study

| | |
|---|---|
| **Date Data Entered** | |

| General Information | |
|---|---|
| **Lab Number** | **Simpson Chert** |
| **District Number** | District 8 |
| **Mix Design Number** | 88Bit1989 |
| **Material Code** | 19545 |
| **Type Mix** | BitConc SC 105 E |
| **District Gmm** | 2.436 |
| **Producer** | MaClair Asphalt |
| **P/S Number** | 1202-07 |
| **Location** | |
| **Contract Number** | |
| **Date Sampled** | |

| Mix Design | |
|---|---|
| **Number of Gyrations, Ndes** | 105 E |
| **Nominal Maximum Size** | |
| **Coarse Aggregate #1** | 031CMM13 |
| **Name of Coarse #1** | Gravel CR CLBQ, Simpson Materials 52300-14 |
| **% of Coarse #1** | 30.1 |
| **Coarse Aggregate #2** | 032MM13 |
| **Name of Coarse #2** | Stone CR CLBQ, Lead Belt Material 52302-45 |
| **% of Coarse #2** | 30.1 |
| **Coarse Aggregate #3** | |
| **Name of Coarse #3** | |
| **% of Coarse #3** | |
| **Fine Aggregate #1** | 038FAM20 |
| **Name Fine #1** | Sand ST F AGG CLBQ, Bluff City Mineral 51192-02 |
| **% Fine #1** | 19.1 |
| **Fine Aggregate #2** | 038FAM20 |
| **Name Fine #2** | Columbia Quarry Co. 51632-09 |
| **% Fine #2** | 19.0 |
| **Fine Aggregate #3** | |
| **Name Fine #3** | |
| **% Fine #3** | |
| **Mineral Filler** | 004MF01 |
| **Name of MF** | Mineral Filler, Mississippi Lime Co., 52302-08 |
| **% of MF** | 1.7 |
| **AC Grade** | |
| **% AC** | 5.5 |
| **Additive** | |
| **% Additive** | |
| **Design TSR** | 0.75 |

| Lab Results | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **Simpson Chert** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Sample 1** | | | | | 2.251 | 2.258 | 2.260 | 2.243 |
| **Gmb, Sample 2** | | | | | 2.248 | 2.253 | 2.259 | 2.257 |
| **Gmb, Sample 3** | | | | | 2.259 | 2.249 | 2.246 | 2.260 |
| **Gmb, Sample 4** | | | | | 2.266 | 2.257 | 2.264 | 2.264 |
| **Gmb, Sample 5** | | | | | 2.268 | 2.255 | 2.262 | 2.265 |
| **Gmb, Sample 6** | | | | | 2.257 | 2.267 | 2.249 | 2.247 |
| **Gmb, Average** | | | | | **2.258** | **2.257** | **2.257** | **2.256** |
| **Gmb, Average Set A & B** | | | | | **2.257** | | **2.256** | |
| **BMPR Gmm** | | | | | 2.428 | | 2.428 | |
| **Voids, Sample 1** | | | | | 7.3 | 7.0 | 6.9 | 7.6 |
| **Voids, Sample 2** | | | | | 7.4 | 7.2 | 7.0 | 7.0 |
| **Voids, Sample 3** | | | | | 7.0 | 7.4 | 7.5 | 6.9 |
| **Voids, Sample 4** | | | | | 6.7 | 7.0 | 6.8 | 6.8 |
| **Voids, Sample 5** | | | | | 6.6 | 7.1 | 6.8 | 6.7 |
| **Voids, Sample 6** | | | | | 7.0 | 6.6 | 7.4 | 7.5 |
| **Voids, Average** | | | | | **7.0** | **7.1** | **7.1** | **7.1** |
| **Voids, Average Set A & B** | | | | | **7.0** | | **7.1** | |
| **% Saturated, Sample 1** | | | | | 71.2 | 71.8 | | |
| **% Saturated, Sample 2** | | | | | | | 71.4 | 71.2 |
| **% Saturated, Sample 3** | | | | | 70.9 | | | |
| **% Saturated, Sample 4** | | | | | 71.0 | 70.2 | 70.7 | 71.8 |
| **% Saturated, Sample 5** | | | | | | 68.7 | | |
| **% Saturated, Sample 6** | | | | | | | 70.3 | 71.4 |
| **Average % Saturation** | | | | | **71.0** | **70.2** | **70.8** | **71.5** |
| **Avg. % Sat. Set A & B** | | | | | **70.6** | | **71.1** | |
| **Cond or Uncond, Sample 1** | | | | | Cond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 2** | | | | | Uncond | Uncond | Cond | Cond |
| **Cond or Uncond, Sample 3** | | | | | Cond | Uncond | Uncond | Uncond |
| **Cond or Uncond, Sample 4** | | | | | Cond | Cond | Cond | Cond |
| **Cond or Uncond, Sample 5** | | | | | Uncond | Cond | Uncond | Uncond |
| **Cond or Uncond, Sample 6** | | | | | Uncond | Uncond | Cond | Cond |
| **Uncond Strength, Sample 1** | | | | | | | 74.2 | 63.6 |
| **Cond Strength, Sample 1** | | | | | 52.5 | 57.3 | | |
| **Uncond Strength, Sample 2** | | | | | 78.0 | 76.4 | | |
| **Cond Strength, Sample 2** | | | | | | | 36.8 | 60.1 |
| **Uncond Strength, Sample 3** | | | | | | 73.2 | 63.6 | 78.5 |
| **Cond Strength, Sample 3** | | | | | 60.5 | | | |
| **Uncond Strength, Sample 4** | | | | | | | | |
| **Cond Strength, Sample 4** | | | | | 58.9 | 60.5 | 60.8 | 54.4 |
| **Uncond Strength, Sample 5** | | | | | 95.5 | | 64.3 | 68.6 |
| **Cond Strength, Sample 5** | | | | | | 66.8 | | |
| **Uncond Strength, Sample 6** | | | | | 82.3 | 84.4 | | |
| **Cond Strength, Sample 6** | | | | | | | 50.9 | 43.1 |
| **Average Uncond Strength** | | | | | **85.3** | **78.0** | **67.4** | **70.2** |
| **Avg Uncond Str., Set A & B** | | | | | **81.6** | | **68.8** | |
| **Average Cond Strength** | | | | | **57.3** | **61.5** | **49.5** | **52.5** |
| **Avg Cond Str., Set A & B** | | | | | **59.4** | | **51.0** | |
| **Avg Uncond Str. w/Additive** | | | | | 85.3 | 78.0 | 67.4 | 70.2 |
| **Avg Cond Str. w/Additive** | | | | | 57.3 | 61.5 | 49.5 | 52.5 |
| **TSR** | | | | | **0.672** | **0.789** | **0.735** | **0.748** |
| **TSR, Set A & B** | | | | | **0.728** | | **0.742** | |
| **Combined TSR, (Cond. w/additive / Uncond. w/o additive)** | | | | | | | | |
| **Comb TSR, A & B** | | | | | | | | |

| Lab Result Statistics | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Lab Number** | **Simpson Chert** | | | | | | | |
| **Plant of Lab Mix** | **Plant Mix** | | | | **Lab Mix** | | | |
| **4-inch or 6-inch Samples** | **4 - inch** | | **6 - inch** | | **4 - inch** | | **6 - inch** | |
| **Set A or Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** | **Set A** | **Set B** |
| **Gmb, Average** | | | | | 2.258 | 2.257 | 2.257 | 2.256 |
| **Gmb, Standard Deviation** | | | | | 0.0079 | 0.0061 | 0.0074 | 0.0091 |
| **Gmb, Maximum** | | | | | 2.268 | 2.267 | 2.264 | 2.265 |
| **Gmb, Minimum** | | | | | 2.248 | 2.249 | 2.246 | 2.243 |
| **Gmb, Range** | | | | | 0.020 | 0.018 | 0.018 | 0.022 |
| **Gmb, Average, Set A & B** | | | | | 2.257 | | 2.256 | |
| **Gmb, STDEV, Set A & B** | | | | | 0.0068 | | 0.0079 | |
| **Gmb, Maximum, Set A & B** | | | | | 2.268 | | 2.265 | |
| **Gmb, Minimum, Set A & B** | | | | | 2.248 | | 2.243 | |
| **Gmb, Range Set, A & B** | | | | | 0.020 | | 0.022 | |
| **Voids, Average** | | | | | 7.0 | 7.1 | 7.1 | 7.1 |
| **Voids, Standard Deviation** | | | | | 0.32 | 0.27 | 0.31 | 0.38 |
| **Voids, Maximum** | | | | | 7.4 | 7.4 | 7.5 | 7.6 |
| **Voids, Minimum** | | | | | 6.6 | 6.6 | 6.8 | 6.7 |
| **Voids, Range** | | | | | 0.8 | 0.8 | 0.7 | 0.9 |
| **Voids, Average Set A & B** | | | | | 7.0 | | 7.1 | |
| **Voids, STDEV, Set A & B** | | | | | 0.28 | | 0.33 | |
| **Voids, Maximum, Set A & B** | | | | | 7.4 | | 7.6 | |
| **Voids, Minimun, Set & B** | | | | | 6.6 | | 6.7 | |
| **Voids, Range, Set A & B** | | | | | 0.8 | | 0.9 | |
| **% Saturation, Average** | | | | | 71.0 | 70.2 | 70.8 | 71.5 |
| **% Saturation, STDEV** | | | | | 0.2 | 1.6 | 0.6 | 0.3 |
| **% Saturation, Maximum** | | | | | 71.2 | 71.8 | 71.4 | 71.8 |
| **% Saturation, Minimum** | | | | | 70.9 | 68.7 | 70.3 | 71.2 |
| **% Saturation, Range** | | | | | 0.3 | 3.1 | 1.1 | 0.6 |
| **% Sat, Avg, Set A & B** | | | | | 70.6 | | 71.1 | |
| **% Sat, STDEV, Set A & B** | | | | | 1.1 | | 0.5 | |
| **% Sat, Maximum, Set A & B** | | | | | 71.8 | | 71.8 | |
| **% Sat, Minimum, Set A & B** | | | | | 68.7 | | 70.3 | |
| **% Sat, Range, Set A & B** | | | | | 3.1 | | 1.5 | |
| **Uncond Strength, Average** | | | | | 85.3 | 78.0 | 67.4 | 70.2 |
| **Uncond Strength, STDEV** | | | | | 9.1 | 5.8 | 5.9 | 7.6 |
| **Uncond Strength, MAX** | | | | | 95.5 | 84.4 | 74.2 | 78.5 |
| **Uncond Strength, MIN** | | | | | 78.0 | 73.2 | 63.6 | 63.6 |
| **Uncond Strength, Range** | | | | | 17.5 | 11.2 | 10.6 | 14.9 |
| **Uncond Str, Avg, Set A & B** | | | | | 81.6 | | 68.8 | |
| **Unc Str, STDEV, Set A & B** | | | | | 7.9 | | 6.3 | |
| **Uncnd Str, MAX, Set A & B** | | | | | 95.5 | | 78.5 | |
| **Uncnd Str, MIN, Set A & B** | | | | | 73.2 | | 63.6 | |
| **Unc Str, Range, Set A & B** | | | | | 22.3 | | 14.9 | |
| **Cond Strength, Average** | | | | | 57.3 | 61.5 | 49.5 | 52.5 |
| **Cond Strength, STDEV** | | | | | 4.2 | 4.8 | 12.1 | 8.7 |
| **Cond Strength, MAX** | | | | | 60.5 | 66.8 | 60.8 | 60.1 |
| **Cond Strength, MIN** | | | | | 52.5 | 57.3 | 36.8 | 43.1 |
| **Cond Strength, Range** | | | | | 8.0 | 9.5 | 24.0 | 17.0 |
| **Cond Str, Avg, Set A & B** | | | | | 59.4 | | 51.0 | |
| **Cond Str, STDEV, Set A & B** | | | | | 4.7 | | 9.5 | |
| **Cond Str, MAX, Set A & B** | | | | | 66.8 | | 60.8 | |
| **Cond Str, MIN, Set A & B** | | | | | 52.5 | | 36.8 | |
| **Cond Str, Range, Set A & B** | | | | | 14.3 | | 24.0 | |
| **TSR** | | | | | 0.672 | 0.789 | 0.735 | 0.748 |
| **TSR, Set A & B** | | | | | 0.728 | | 0.742 | |
| TSR DIFFERENCE, 6" - 4" | | | | | 0.014 | | | |